HOUSE OF LORDS SESSION 1994-95

SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

ACADEMIC RESEARCH CAREERS FOR GRADUATE SCIENTISTS

EVIDENCE

Printed pursuant to the Order of the House of Lords of 22 November 1994

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CALL FOR EVIDENCE

The House of Lords Select Committee on Science and Technology have appointed a Sub-Committee, under the chairmanship of Lord Dainton, to enquire into Academic Careers for Graduate Scientists.

The Committee's enquiry will examine the current arrangements under which research scientists work, with particular reference to the perceived dependency on short term (c. 3 year) contracts. It will focus on the case for improving career security and ways of doing so and will cover two closely related issues: the position of women in science, and the Government's proposed Master of Research (MRes) qualification.

The Sub-Committee invite written submissions on any matters relevant to the above and in particular on the following questions. It may be that not all the questions will be relevant to your concerns, in which case you should be selective.

(1) What are the problems and advantages of the current career structures for academic scientists in the UK?

(2) What are the advantages and disadvantages of the growth in short term research contracts in academic science?

(3) How do you expect the situation to change in the next decade? (Please bear in mind, among other factors, the current age structure in full-time university posts and expected changes in university income levels and sources.)

(4) What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?

(5) What should be done to improve the mobility of scientists between academia and industry?

(6) How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?

(7) The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.

INSTRUCTIONS TO WITNESSES

Evidence should be submitted to the Clerk of Sub-Committee II (Academic Careers for Graduate Scientists), Select Committee on Science and Technology, House of Lords, London, SW1A OPW by **17 January 1995**. Evidence must be clearly typed or printed on A4 paper (single-sided) and take the form of an original copy. It would assist the Sub-Committee if evidence were prefaced with an executive summary or precis. It would be extremely helpful if evidence could also be submitted on a disk, preferably as Word Perfect 5.1 or 5.0, or if this is not possible, as a DOS text file or ASCII. (Disks will be returned to sender.) Evidence becomes the property of the Committee, and may be printed. You may publicise your evidence between submission and publication, but in doing so you must indicate that it was prepared for the Committee.

On the basis of written evidence received the Committee will invite some witnesses to give oral evidence.

You may follow the progress of the enquiry from the Weekly Agenda of House of Lords Select Committees. This is free, and may be ordered from Miss Sue Hunt, Committee Office, House of Lords, LONDON SW1A OPW, telephone 0171-219 5791.

Further information from the Clerk, David Batt, House of Lords, London SW1A OPW, telephone 0171-219 6798; direct line 0171-219 6612; fax 0171-219 6715.

MINUTES OF EVIDENCE

TAKEN BEFORE THE SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

TUESDAY 24 JANUARY 1995

Present:

Craig of Radley, L.	Phillips of Ellesmere, L.
Dainton, L. (Chairman)	Redesdale, L.
Dixon-Smith, L.	Renwick, L.
Hilton of Eggardon, B.	
Howie of Troon, L.	Platt of Writtle, B.

Memorandum by the Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom

CAREERS OF CONTRACT RESEARCH STAFF

ISSUES

Strategic

1. The number of research staff employed on fixed term contracts is so great, and the turnover in staff holding permanent academic posts so low, that the assumption that an individual will move from a fixed term to a permanent contract is now true in only a small minority of cases.

2. The longer an individual spends in research, the more difficult it may be to find other employment. He or she may be seen as over-qualified and lacking relevant experience. If the same individual had worked on a fixed term teaching contract he or she might be seen as possessing skills which are more transferable.

3. Though there are, almost always, sufficient candidates to make an appointment, it may be that some of the best are deterred from accepting an appointment if it is for a fixed term. Moreover, it is likely that insecurity, possibly affecting performance, may set in not long after taking up the appointment. (It would be helpful to secure some evidence on this point.)

4. The relatively short time-span of a fixed term contract must mean that much energy is devoted to securing the next contract and failure to do so must mean the break-up of successful as well as unsuccessful research teams. The ability of universities to counter this effect through the use of funds to "bridge" intervals between contracts is limited by the availability of funding.

5. The most self confident or committed researchers may be content to build their careers through a succession of contracts but even many of these must eventually look for greater job security, eg if family responsibilities increase. On the other hand it has to be acknowledged that solutions to these problems may themselves create new problems, eg what to do if a researcher with a permanent contract ceases to be productive. However, this problem is no different in kind from that which may arise in relation to staff with permanent appointments and those problems are usually solved.

6. The overall solution is clear; there is a need for more secure and longer term funding arrangements for proven contract research staff.

Salary/conditions of services entitlements

7. Apart from these strategic issues there are others which may arise from the separation of the "employer" and "paymaster" roles. The CVCP and AUT have tried to tackle some of these issues via a code of practice but more is needed. Contract research staff argue that universities perceive the Research Councils as unwilling to allow for salary and related costs except at the lowest possible level. In consequence, they say, principal researchers are reluctant to submit bids for research grants which take full account of their institution's own employment policies. The effects of this are felt particularly by researchers seeking a second or subsequent contract. Some universities have dealt with this problem by requiring grant applications to be vetted by a special team.

8. Staff on fixed term contracts claim that:

(a) second appointments are offered at the bottom of a scale even though the individual concerned may have already attained a higher salary under an earlier contract;

(b) appointments are offered at a lower grade when a permanent employee would have progressed to a higher one;

(c) researchers are not always included in merit pay reviews;

(d) staff are reluctant to take their annual leave entitlement because they believe the grant has not provided for it;

(e) universities will only give maternity leave and pay if funders will meet the cost; and pay during long term sickness is cut off unless the funder will meet the cost.

Concerns of Research Councils

9. For their part Research Councils, and other funders, have expressed concern about the extent to which universities may be fulfilling their responsibilities in relation to researchers, eg in relation to supervision, training and careers advice and development.

SOLUTIONS

A new compact

10. Solutions to the strategic, the salaries/conditions and Research Councils' concern issues will only be found through co-ordinated action by "employers" and "funders" based on a much clearer definition and explanation of the respective responsibilities expressed through model contracts of employment on the one hand and revised grant regulations on the other.

11. All the parties to such a new compact would have to accept that there would be a small increase in staff costs.

A range of possible components

12. Components of such a new compact might include:

(a) Principal researchers might be relieved of some of their teaching load (by appointing substitute teachers) so as to increase the supervision of researchers and provide even more active participation in research.

(b) The number of researchers employed on indefinite contracts could be increased.

(c) The proportion of grants made for longer periods could be increased.

(d) Terms and conditions of service for contract researchers should be made comparable to those for established staff especially those terms related to grade and salary point in case of experienced researchers.

(e) No distinction, based on the length of contract, should be made in respect of the availability of maternity leave and pay or sickness pay.

(f) 'Bridging funds' could be built up to ensure the retention of researchers between the ending of one contract and the start of a highly probable next grant (or to give a redundancy payment where a renewed contract is unlikely).

(g) Research staff should be fully included in staff development and training programmes taking account of career aspirations.

(h) A reward or penalty system could be introduced to encourage universities to fulfil their responsibilities in relation to supervision, career development and guidance.

Memorandum by Professor F W Bullock, University College London

The Provost, Dr Derek Roberts, has passed your letter to me for response.

At your recent visit to University College I provided you with documents detailing our Contract Research Staff Career Scheme which is in its first year of implementation. These documents contain partial answers to some of your questions. I hope they will be included in the portfolio of evidence as an indication of what can be done to alleviate some of the problems facing Institutions that have large research activity and therefore a large cohort of graduate scientists seeking academic careers.

Further comments on your specific questions are as follows:

(1) *What are the problems and advantages of the current career structures for academic scientists in the UK?*

. The problems are discussed in detail in the documents already supplied. Basically, the funding bodies (Research Councils and Charities) have not assumed any responsibility for providing a career structure for the scientists they fund. Such "career" positions (Advanced Fellowships etc) as *are* funded are (with few exceptions) still short term in the context of a working lifetime and are usually linked eventually to an

Institutional promise to continue support after expiry of the award. In any case, there are so few of these advanced awards that they make little impression on the overall problem.

Nevertheless, these awards are prestigious, highly regarded and an essential part of science funding. There should be more of them, with mechanisms to assure longer term financial commitment. In particular, increased availability of "career" Fellowships without proper thought being given to the funding aspects, may have the potential long term effect of changing the balance of a Department's or Institution's academic activity. If a Department is obliged to transfer these (probably very productive *researchers*) to the permanent academic staff after say 10 to 15 years, their appointments will necessarily be to senior academic posts (Reader or even Professor) with the understanding that research will continue to be their principal activity. Without appropriate increase in funding, a Department cannot then easily recruit the sort of staff prepared to take on a reasonable *teaching/administrative* load and the pursuit of excellence in research may lead to a decline in excellence in teaching.

This raises the related point of why there should continue to be *separate* accountability exercises directed at research and teaching? The excellence, or otherwise, of a Department or subject area should surely be judged on the amalgam of its teaching and research activity. Although not a matter directly for this enquiry, the balance to be achieved between teaching and research activity, and the optimising of excellence in both within available resources, is something not entirely divorced from the problems of providing academic careers for graduate scientists!

(2) *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

The advantage is clearly that more science can be done by fewer permanent academic staff. The disadvantage is, just as clearly, that Institutions, underfunded as they are, will continue to maximise their research activity at least cost by continuing to encourage their permanent academic staff to seek external short term funding for research staff with no commitment to long term support of research staff.

(3) *How do you expect the situation to change in the next decade?*

At present there is no incentive to change and if nothing is done there will continue to be growth in the numbers of researchers on short term funding. Change (or at least a slowing of the trend) will mainly come about either by Universities and funding bodies providing better defined career structures, or by young post docs increasingly realising that there is no career in academic research. The unfortunate corollary of the latter is that graduates will increasingly be unwilling to undertake post graduate research degrees. I believe this attitude is now common in some disciplines. The outcome of this scenario may be to achieve a greater flow of graduates into industry but with less capability for innovation.

There is an even more serious trend. Most bright A-level students realise there is virtually no chance of a well paid career in science even though they may be attracted by the intellectual challenge of reading for a science degree. If the economy really picks up we shall find that the best science graduates will not take up a higher degree nor even look for a career in science, but will instead go into finance etc. This will leave a poorer quality graduate pool from which the next generation of full-time academic staff can be selected.

(4) *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

Very little! Many go on to further short term employ in other Institutions and some to fill the few permanent academic posts available. Most end up eventually in industry or commerce but it is almost impossible to keep track of those who leave and therefore to know how long they stay in the contract research sector. Some Professional Institutes (IoP, IoB, Roy. Soc. Chem etc) compile data on subsequent employment of post-docs after they leave the University sector.

(5) *What should be done to improve the mobility of scientists between academia and industry?*

Get industry to sponsor research which is not tied directly to wealth creation but enables researchers to have access to specialised technology. In this way the researcher will have the freedom to pursue independent research but at the same time will see the advantages of working within a much better funded environment. Another effective strategy would be for industry to fund many more undergraduate and postgraduate bursaries than currently available. Students appreciate the opportunity to spend some time working within the industrial environment; but more so appreciate the increased maintenance funding which industrial bursaries usually carry.

We have first hand experience of this in dealing with the overwhelming numbers of high quality applicants for PhD studies in the SIRA-UCL Postgraduate Centre. We also know that many of the students supported by industrial bursaries do indeed find their first destination employment with the sponsoring firm. There is little doubt that industrial bursaries, both undergraduate and postgraduate would be highly sought after; industry would get good quality people and the increased contact between academics and the sponsoring industry would lead to greater mutual understanding and more collaboration. Industry needs to be encouraged to think in terms of long term collaboration, not just for the lifetime of a project grant or bursary. The government should be encouraged to promote an increase in this activity by making such industrial support tax beneficial.

(6) *How do you expect the situation concerning women in science engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

Much effort is being put in by Universities to attract women to science and engineering, with considerable success. There is no doubt that a change in the cultural attitude of women to these subjects has taken, or is taking, place. Within the decade, I confidently expect the proportion of women reading these subjects to have undergone a substantial increase. However, schools must play their part by presenting science not only as a suitable discipline, but also as an interesting one. There is still a widespread tendency for schools to propagate the belief that science is "hard", rather than demonstrating that it is not. By the time potential students are looking for a University place it is too late to convince them of the attractions of a scientific education.

(7) *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

University College has expressed strong support for this scheme and confidently expects to play a major part in the pilot exercise. It therefore endorses the philosophy behind the scheme, but deplores the fact that MRes studentships are, apparently, to be found at the expense of PhD studentships. We have in place all the necessary infrastructure to deliver the components of these new degrees through the flourishing Graduate School, which can provide all the general competencies required, and our extensive research activity, which enables students to receive highly specialised instruction and participate in large research projects. If the government is really serious about generating highly qualified human resource with the prime object of feeding industry, then perhaps it should be doing more to encourage industry to provide funds (bursaries, equipment, academic staff, etc) to train that resource!

What should not be lost sight of in launching this new type of Masters degree is that, whether or not the pilot study leads to more permanent support for the qualification, the correct and necessary period for progress from A-level standard to Phd in scientific disciplines is seven years irrespective of whether it is broken into 3 + 1 + 3 years or 4 + 3 years, or even 1 + 3 + 3 years.

I trust the above few remarks will be of assistance to the Sub-Committee.

Examination of Witnesses

Dr K Edwards, Vice-Chancellor of the University of Leicester and Chairman of CVCP, Professor B Fender, Vice-Chancellor of the University of Keele and Chairman of the Universities and Colleges Employers Association, and Professor F W Bullock, Vice-Provost University College London, the Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom, called in and examined.

Chairman

1. Thank you all very much for coming. Is there anything you want to say at the beginning by way of elaboration of any of the points, or to give us anything about the background of the thinking which has gone into this from the point of view of the CVCP? Perhaps I should add another point which you may or may not be aware of: because Dr Roberts is unable to come, I have just received this morning, in response to a call for evidence, a letter from his subordinate which answers the questions in the call for evidence. Since this has not been put round to the Committee, because there has not been time, may I invite you, Professor Bullock, when the time arises and you think it is useful, to bring out these points for the benefit of the Committee.

(*Dr Edwards*) Thank you very much, my Lord Chairman, for the opportunity to come and talk to your Committee. We have made a submission and have got the questions. I have to say very little by way of a general introduction, but just to draw attention to the fact that in recent years there has been a massive increase in the amount of research funding coming into universities from a wide variety of sources—a high proportion in the past from industrial sources of one sort or another. I think we have been very successful in doing it. We see ourselves as doing two things in the universities: one is obviously doing research and providing the output from research; and the other is providing trained researchers, some of whom may continue to work in academia, but many of them will not. It is that sort of background. As you will know, my Lord Chairman, we have had discussions in the past with the Research Councils. At the moment we are waiting for the Research Councils' proposals to deal with some of these issues. I understand they are likely to be forthcoming very soon. The idea is that there should be some sort of concordat between the Research Councils and the universities on the way in which we deal with the contract research workers to

[Chairman *contd.*]

provide them with the best possible advice. Two questions arise here. One is: what is the total size of the research activity in the United Kingdom for which we are trying to provide a pool of trained researchers? Is it expanding or is it static? Certainly in terms of the university population the numbers are relatively static. The number of people who complete research contracts in any one year is about five times the number of vacancies likely to arise in university positions. Since we are providing a much wider range, maybe that is all right, but there is the question of the total size. The second issue (and one with which we would be particularly concerned in our discussions with the Research Councils and indeed with some of the other major agencies like major medical charities who fund our work) is the question of the appropriate training we can provide and the experience we can provide for these people so that they receive careers advice and so on. It is with those two issues that we have to be concerned. I imagine our concern particularly is with the second group of issues. There is a corollary to that which is, given that a certain amount of money is coming to universities, is the best quality of research provided by having a rapid turnover of people on short-term contracts, or by having a certain number of people who have got much longer career potential in full-time research and can use their training and skills accordingly.

2. Thank you very much. I wonder if we could get to the nub of this problem as some of us see it: how long is this problem going to be with us? You speak of the fact that there are very few vacancies which are available for people to be appointed to permanent jobs. I am leaving aside for the moment one or two of the schemes like Imperial and University College, and probably elsewhere for taking care of people who have a lot of part-time problems. The argument must be that as time elapses the whole age group distribution moves and drops off at the end as they get to retiring age. A point must come at which your number of opportunities for making appointments (assuming the ratio does not deteriorate) does create some light at the end of the tunnel. Have you done any work on this? It seems to me it should be part of your argument to the Government for a bid for funds.

(*Professor Fender*) I do not think we are necessarily that far away from the equilibrium position. The average age of university staff has increased, and is still increasing slowly, but I suspect we are getting quite close to the maximum of that growth. You might argue that is still a little high, but I do not think the idea that there would be an enormous number of vacancies is going to address this particular problem. This problem, if we describe it as a problem, is likely to grow larger rather than smaller. I say that because the research income of universities is now consistently rising at a level of about 6 per cent per annum in real terms, and the main vehicle for that external research income, the main way of expressing that, is the short-term contract researcher. I do not think we should treat it as a problem. I think there are ways in which we can make that system operate better.

3. By making the statement you have made, saying you think it must be treated as a problem because of the increasing number of posts coming forward, you are implicity saying that it is not matching those dropping by retirement. Therefore you must have done the calculations. May we see them?

(*Professor Fender*) If one could guess into the future reliably then one could produce the data. The turnover rates will fluctuate and they also vary quite a lot from discipline to discipline.

4. Yes, Professor Fender, but have you got any real data on this subject which we could look at?

(*Professor Fender*) We could do projections of that kind if you would find them helpful.

5. I speak for myself but I suspect others round the table might feel similarly.

(*Dr Edwards*) We do obviously have the age profile of the permanent academic staff, which is published and we could certainly submit it. We are talking about the old universities, and this is from an answer in the House of Commons in November 1994, and shows that of 23,000 in the English Universities about 3,800 were 55 and over, and about 8,600 were between 45-55, and then the numbers are lower as you get to the younger age group. We have figures from the past at the rate at which people resign and move out of the system and we could produce some figures. I think they are still way short of the present number of short-term contract researchers who are completing their period of employment.

6. Could we turn now to the other point Professor Fender was making, which was the increase of 6 per cent from non-university sources, or at least public sources by charities and the industry: have you any evidence that is going to continue? There has been a considerable surge.

(*Professor Fender*) There is not hard evidence about it. I cannot quite see why it should not, because you have got new funding sources coming in. Europe and overseas sources are ones which show a significant increase. Even through the recession the income to universities from industrial sources rose, and rose quite strongly. One might expect that to pick up again. I cannot really see any forces which would restrict that growth. It may not be as rapid as it has been over the last decade, but I would be very surprised if there was not a growth.

Lord Dixon-Smith

7. If the volume of funding is growing at this rate, although in one sense the problem of people on short-term contracts is an expanding problem at the same time it is not a problem since if one contract ends it is highly likely somebody would be able to roll over into a fresh contract. It seems to me the real concern was that we were producing people who were researchers with nothing to go to. It seems to me that may not be something we have to worry about.

(*Professor Fender*) That is not the only concern. What we want to do is to make sure we are producing the best research we can, and that means optimising the conditions and the career prospects for this rather large cohort of short-term contract staff. I think one of the big growth areas is in the social science area, where increasingly research money is coming in in quite large sums and there the short-term contracts

[Lord Dixon-Smith *contd.*]

tend to be of even shorter duration than those typical in the sciences or engineering. I think there is a problem in the sense that I believe we ought to be able to provide more satisfying and more effective careers for these university short-term contract staff without pretending we can go anywhere towards offering a high proportion of them guaranteed employment for life.

Baroness Hilton of Eggardon

8. Even if you have a 6 per cent increase in funding each year you are, nevertheless, getting new graduates coming out of universities at the bottom end. That is presumably a greater number than the number of people on short-term contracts who are going out of the system. Do you have any figures on the people who are being totally lost to the science world because they cannot get new short-term contracts, presumably because some of their places are being filled by new graduates who are cheaper to employ coming in at the bottom of the salary scales? All those things we know about in the teaching profession, for instance, where it is cheaper to employ newly qualified people rather than people who have already done several years within the research system.

(*Professor Bullock*) I think that is an excellent point which should be borne in mind. You have tried to make the argument that to maintain equilibrium in numbers of staff then you could replace the bulge going out at one end with contract research staff coming in at the other. That is part of the argument. In point of fact, the input to the university sector staff is not simply coming from those people who have been employed on a short-term contract; it is made up very much as well of precisely the people Lady Hilton has mentioned, plus people we retrieve from abroad, from industry and so on. The equilibrium would not be maintained simply by feeding in at the bottom end contract research staff to replace those going out at the top end. It is important that in the university we always have to maintain room for young, promising people who we would want to be on the permanent academic staff of the institutions, who may not yet have necessarily shown their complete research potential but, nevertheless, we know are good teachers, for instance, and whom we would want to bring into the system. That is one point. If I may make a point in response to a question raised earlier concerning the continuation of support through short term funding. What you say is absolutely true, in the sense that you could expect when one contract ends another contract would take over and that could roll on to another and so on. In fact, that is what has happened, and that has been basically what has been wrong with the system. Although funding for a certain percentage of these people has been maintained, what has not been given to them is the security which they need in order to be free to pursue the research and career they would aspire to. Although we cannot produce figures, I strongly suspect that many of the top researchers, many of the top people, realise that this situation of short-term contracts is unsatisfactory, do not wish to continue in an insecure position, and are lost to the system. I am not quite sure what I mean when I say "lost". We might lose them to areas of industry which the country would like to see them being lost to, as it were. Nevertheless, certainly some of the top researchers will be lost to the university sector anyway because of this perception that maybe they cannot aspire to some kind of secure career.

Chairman

9. This does raise the point of missing data for the destination of people who do leave, and particularly at the post-doctoral level and various levels. It has been mentioned to me privately that some of them are lost to other countries which is clearly quite a serious loss. As you mention, some of the losses are to the benefit of industry and the country generally. This seems to be an obscure area. One of the points which has come out from the Royal Society, on which I would like your views, is perhaps there should be longer term research fellowships for very gifted people. Is that the view of the Vice-Chancellors?

(*Dr Edwards*) Yes. We do support this proposal. I think we need to be parties to the decisions about who these people are, particularly if there is a clear expectation, as in many cases, that the responsibility in funding them will be taken over by the universities. There are a number of schemes in which we do this. Although the University College has one of the best known formal schemes, there are less formal schemes operating in many universities about making forward commitments to take people on to the permanent staff.

10. This must be very difficult if you are a relatively small university with not a great turnover and when you have got all your grant very specifically directed towards particular objectives, and you do not have what a firm would have, namely, income from your products which you could devote to the benefit of the company as a whole. Is that one of the problems you have?

(*Dr Edwards*) It certainly is, and it is why many universities that are not as large as University College would find it hard to produce a formal scheme of that kind, which carries with it certain expectations about the particular proportion of the contract researchers who are likely to be able to make permanent posts.

11. This runs just a little beyond our remit but obviously it would be easier to manage a system if research were concentrated in a small number of institutions which were large. I imagine the Committee of Vice-Chancellors and Principals by its very nature would not feel it wanted to express a view on this?

(*Dr Edwards*) That would be a very fair assumption, my Lord Chairman. Opinions differ considerably in the Committee of Vice-Chancellors as to whether it would be a good or bad thing.

(*Professor Fender*) There is a particular factual point. If you look at the number of research only staff in universities which are funded out of university general income, you would not be able to discern a pattern there, which was linked to the size of the institution. It is clear that small universities do find

[Chairman *contd.*]

resources to employ research only staff out of their own funds.

12. That is a very interesting comment.

(*Dr Edwards*) If I may just add to that. It reflects the increased concentration of research efforts even in small universities in a rather more limited number of fields than would have been the case before the research assessment exercise.

Lord Phillips of Ellesmere

13. To what extent do you think the situation (I will not call it a problem) is influenced by the research assessment exercise? A university needs research assistants or even research leaders in order to do well in a research assessment exercise. The number of research assistants also figures in the funding formula associated with the research assessment exercise, so the universities cannot afford not to have a large number of research assistants.

(*Dr Edwards*) That is certainly true. The dilemma is, if you have those who are well established their contribution to the quality of the exercise is likely to be higher than if they are not well established. On the other hand, if for the same money you can get a larger number of bodies it will increase the volume, and have a multiplier effect. Of course, given that these pressures are upon us, inevitably we do try to make these sorts of calculations.

Lord Renwick

14. If you are employing somebody on a temporary basis it is usual that you are going to pay them more than if they are on a permanent basis. Is that true?

(*Dr Edwards*) No, it is not true. The scales are such, whether they are employed on a permanent basis or on a fixed term contract, that their rates of pay will be very similar.

Lord Redesdale

15. Is this not the fundamental problem? Is it one which can have a solution, with the fact it is all down to cost? The reason there are so many short-term contracts is because the universities find the cheapest solution for filling their places. It is a problem which does not really seem to have a solution.

(*Dr Edwards*) I think there is more to it than that, my Lord Chairman. We at the universities are keen to get a constant succession of research grants. The research grants that are on offer, as it were, are likely to change from time to time as fields develop. To have a supply of people with the right sort of background to tackle the problems does imply some degree of turnover in staff.

(*Professor Fender*) If I could put it in a slightly different way. There are two pressures: one is a shortage of funding which drives you to more flexible working, and means you keep the contracts as short as you possibly can to deliver the particular bit of research you are contracted to do; but there is another tendency and that is for increased professionalisation in research. In order to compete for those external sources of funding we have to be able to demonstrate we can deliver the research. That would tend to drive you to more experienced and longer term contracts, including an increase in the number of permanent ones. The forces are not all one way. What we have to do in universities is try to encourage the funding agencies to provide their money in a way which maximises the effectiveness of research and at the same time (and the two are linked) increase the job satisfaction of those doing the research.

Chairman

16. From your point of view, as university administrators, may I take you to two points. Firstly, by and large over the years, the notion of cost centres being individual departments has developed, and that means the effective unit of management from the point of view of resources is smaller, and that means the system gets less rather than more flexible, unless there is a university policy over losing some of the resources for the general good. Secondly, are the universities moving towards more permanent research appointments paid from their own funds in the long term?

(*Professor Fender*) Roughly, the figures have increased from about 900 to 1,600 over the last decade.

17. Of permanent appointments?

(*Professor Fender*) I assume they are permanent. They are wholly university-funded (from central sources), research only staff. That figure has increased, and has increased roughly in proportion to the number of short-term contracts. It suggests to me that universities, in responding to increased professionalisation, are prepared to increase the number of people who are dedicated to research.

18. Does this put a greater burden on those who are not so dedicated in terms of teaching and general administration?

(*Professor Fender*) I think it is certainly true that what might now be termed the old fashioned notions of equal distribution of function, teaching, research and administration among all academic members of staff, is going or in many cases has gone. Indeed, the professionalisation requires you to target the particular functions to suit the individual.

19. Do you believe it is good for the university?

(*Professor Fender*) Yes, I think I would say that. I think there is satisfaction to be obtained at both ends of the spectrum—a satisfaction from those doing a little research and a lot of teaching and the other way round.

Lord Howie of Troon

20. In paragraph 11 of your submission it says that a new compact would lead to a small increase in staff costs. Could you explain how that comes about? How small is small?

(*Professor Fender*) There are three costs which one could identify in trying to move to better conditions of service. One is, if we were to extend the period of a contract, because we still operate on an incremental

[Lord Howie of Troon *contd.*]

scale, that would take the average cost up. That is the first cost. That might be quite significant if you went from a series of two-year contracts to five-year contracts, for example. The second cost is the cost associated with continuity. If you try to keep people in-post working on their research area and the grants do not lock together but end on time then there is going to be a cost associated in the interim. The third cost is associated with improving the access to career facilities, which I think would be beneficial to all. By that I mean proper arrangements for staff development, for an appraisal in terms of career planning and so on. That takes a certain amount of resources. It would be quite reasonable to spend 2 or 3 per cent of the individual's salary on those modern people-management tools. There are three areas I believe of increased costs.

21. I can see that. Quite apart from a new compact, is that not already implicit in the codes of practice agreed between the CVCP and the AUT where there are recommendations on salary skills and all that sort of thing -all of which seem very sensible and seem to point in the same direction?

(*Professor Fender*) Yes, but we have not been able to urge this compact on universities or on our colleagues because, although we did reach this agreement with the AUT (and perhaps we went further than we might now do in terms of conditions of service and union negotiations), it does depend on the funding bodies signing up to the compact. Unfortunately, the Research Councils, no doubt suffering from the same squeeze on resources we have felt in terms of general university funds, did not feel able to do that at that time. I hope they will come back. I hope the discussions which are going on at the moment will enable them to come back and say that the proposals in this document are indeed sensible ones, and should be shared jointly between the universities and the funding bodies.

Chairman

22. You are holding discussions with them at the moment, are you?

(*Dr Edwards*) Yes, CVCP periodically attends some meetings of the Science and Engineering Base Co-ordinating Committee. I understand we will shortly be receiving from the Research Councils a draft concordat of some kind, on which we hope we and they can reach some agreement.

Lord Howie of Troon

23. Do you mean that, despite this agreement with the AUT, which I realise is an agreement on recommendations, you are unable to deliver?

(*Dr Edwards*) I think we would claim we have delivered on some of the elements. Certainly those which involve an extra cost have to be seen as part of an agreement with the funders.

24. If you look at your paragraph 8, the staff seem to make a number of claims which all amount to complaints. You do not seem to me to have delivered a great deal if these claims are true.

(*Dr Edwards*) Some of the issues there clearly involve funding. For example, "appointments are offered at a lower grade when a permanent employee would have progressed to a higher one", I think they are matters of some argument about each individual case. Researchers are not always included in merit pay reviews. These all have funding implications and, therefore, do require some sort of agreement between the university and the external funder. The pattern has been, if these issues arise, there has been an approach to the Research Council or to other external funders. In many cases it is now a matter of practice that the promotion which has been earned on merit would actually be paid for but not from all external funders.

25. All of these complaints are covered in your recommendation but that was four years ago. What has been going on over these four years?

(*Dr Edwards*) We tried to negotiate an agreement with the funders, particularly the Research Councils.

26. Not a very good one.

(*Professor Fender*) In the absence of that agreement with the funding agencies, we have urged universities to do all they can within their resources. If I may quote from the CVCP's document from the working party which I have chaired: "The study group recommends that universities should identify the concrete issues affecting fixed term staff and take action to bring their conditions of service, except length of contract, into line with those of teacher/researchers. They should not wait for a lead from elsewhere". It is not for CVCP to dictate to universities how they should manage their staff, but I think you can agree in that paragraph we have said all we possibly can, short of being a funding body ourselves, to encourage universities along the right lines.

Chairman] We shall have the opportunity a week today to probe the Office of Science and Technology and the Director-General of Research Councils on questions such as this.

Lord Craig of Radley

27. Dr Edwards, your strategic issue number 2 raises (and is related to some of our earlier discussions) the problem that the longer an individual spends in research the more difficult it may be to find other employment. Could you expand on your thinking here? Is it because you are concerned that there are a large number of people who would like to be looking for other employment but are finding it difficult to do so? Or is it the other way round, that because it is so difficult more needs to be done to enhance academic research opportunities in order to give these people longer term employment?

(*Dr Edwards*) I think it is the first of your two categories. If an individual has taken a succession of short-term contracts that are carrying out research on a succession of probably slightly different research grants and research projects, but nevertheless working in the same field, their technical experience can become rather narrow, and maybe they have not had an opportunity to develop research leadership. It may be that after three successive three-year grants, i.e. a nine year period, they are not in a stronger

[Lord Craig of Radley *contd.*]

competitive position for jobs, whether within academia or outside, as someone who has, for example, had a nine year programme in which they had a considerable input of their own and were able to exercise research leadership.

28. Can I assume, because this is the second strategic issue in your list, that there are probably quite a number of people who are affected in this way. Is that your view?

(*Dr Edwards*) Yes. I am afraid I do not have the figures. The fact that it is a concern is illustrated by our support, for example, for the Royal Society's proposal to have longer term fellowships, for those contract researchers who have shown some evidence of having the potential to provide research leadership and to be independent researchers. We do recognise those opportunities have been lacking and, therefore, it implies we feel some of the people on short-term contracts have not had those opportunities from which they could have benefitted.

29. You have no specific figures?

(*Dr Edwards*) No.

Lord Phillips of Ellesmere

30. Just following up that particular point. It seems to me to be the responsibility of the staff research leader to help develop the research capability of the research assistant. Surely if this research leader assumes his research for his post-doctorate is three years' experience or two years' experience and he has ideas, surely those ideas feed into the joint research programme. It is the responsibility of the university staff to promote that person's career.

(*Dr Edwards*) I absolutely agree. If that particular individual happens to get another three year grant within the same research group working with the same principal investigator and research leader, that clearly ought to be happening and that is a responsibility which I fully accept we have and should make sure we put in place. I was concerned more with the individual who may move to a different university or different group even within the same university and does not have the same continuity of contact with the same principal investigator.

Chairman

31. This rather forces back the issue of serious consideration to departments, does it not?

(*Dr Edwards*) Yes.

(*Professor Fender*) I think it is a three-way split, is it not, with the research leader and perhaps the department as one. Then there are the individuals themselves. We have to reckon they too must take appropriate steps to try and make sure they are heading in the right direction. Finally, there is a university responsibility to make sure that the policies within which the research leader or department operate are as effective as possible.

Lord Phillips of Ellesmere] This is a concern which is very well set out in Professor Fender's paper from which you have just quoted. As I said earlier on, it seems to me there is pressure on the departmental research group to maintain its level of activity and its number of research assistants because of the pressures of the research assessment exercise and so on. There needs to be a countervailing managerial pressure from the institution to make sure that the research assistants are not being exploited unfairly, that they are not being given unfair expectations, and that they are counselled to look after their own careers in the area to which they are most suited and, if necessary, given some training to enable them to go out and do something else.

Chairman

32. I want to invite you to expand on something else in your response. Amongst the papers you put to us you were concerned about the fact that with an overdevelopment of research arising from the nature of the HEFCE funding, where the quality of research draws in money from public funds, there might be a tendency to downgrade the teaching element of the department (your words, not mine), and that that could in fact end up with the goose that laid the golden egg being killed, and you rather deplored it in relation to the funding in this context. Would you like to answer that, as well as the other point? I am hoping you will be able to tell us something about the University College scheme which enables the ameliorating effect of the control of the university funds to be brought in in the way in which Professor Fender suggested and which Lord Phillips clearly wants?

(*Professor Bullock*) One of the inherent and crucial parts of the scheme we have developed at University College London is to make sure that the contract researcher is aware at all points in his career, up to the point when he might or might not be taken on, not just of how he is doing in research, but also aware of the fact (if it is the case) that there is very little prospect of him actually being taken on eventually as a permanent member of staff. We feel that is an inherent part of this whole problem. We must not conceal from you the fact that universities have been somewhat lacking in providing proper advice to contract research staff in the past. Many members of contract research staff have been employed continually on short-term contracts without actually having ever been told that this is not going to lead to anything more permanent in the future. That is something which is very crucial in any scheme one evolves. It is obviously something which has to be looked into, and we have put it into our procedure as an inherent part. The contract research staff member, after three years, has a pretty good idea of whether he is going to be on course for consideration for permanent employment, or whether in fact he is not. At the most he will have spent only three years of his employment with us, and can then think about going out to some other career, rather than trying to pursue an academic career which he may not be suited to or capable of. I wanted to make that point because I think it is an important point of any scheme. The point, my Lord Chairman, you were asking me to comment on, I was not quite clear what you meant. Were you asking me to comment on my response to your first question?

[Chairman *contd.*]

33. Yes, where you say this may lead to a decline in excellence in teaching from the pursuit of excellence in research. Some people would argue this the opposite way.

(*Professor Bullock*) Maybe, yes. I do not think I can really do any better than I have written here.

34. I am afraid my fellow Committee members have not seen this.

(*Professor Bullock*) Perhaps, for clarity, I could read the paragraph to which you are referring. I made a comment on the advanced fellowships that were funded, and the fact that they were nevertheless "still short-term in the context of a working lifetime and are usually linked eventually to an institutional promise to continue support after expiry of the award. In any case, there are so few of these advanced awards that they make little impression on the overall problem. Nevertheless, these awards are prestigious, highly regarded and an essential part of science funding." I then made the point that there should be more of them, and I think this is where my Lord Chairman is suspecting there is some ambiguity because I go on to say, "In particular, increased availability of 'career' Fellowships without proper thought being given to the funding aspects [and perhaps I should have underlined that phrase], may have the potential long term effect of changing the balance of a Department's or Institution's academic activity. If a Department is obliged to transfer these (probably very productive *researchers*) to the permanent academic staff after say 10 to 15 years, their appointments will necessarily be to senior academic posts (Reader or even Professor) with the understanding that research will continue to be their principal activity." Without some appropriate increase in funding, a Department would find it difficult to recruit staff easily which could maintain some kind of reasonable balance between teaching and administration, on the one hand, and research on the other. The consequence could be that the pursuit of some excellence in research by this route could conceivably lead to some decline in the excellence of teaching. I think that was the point I was making. It may be a small point but, nevertheless, it is a point which has been made to me by some senior members of the staff at University College, and I think it is arguable.

35. I want to ask you whether we have got the wrong impression or not. My impression from what you have said is that you are finding this a period of change in your sources of funding which is very difficult to manage but this is fundamentally a managerial problem. You do not seem to have all the data you need to move numbers about in order to look ahead, and you have not yet got an agreement with the major funding bodies, research charities and Research Councils. Is that broadly a problem which you as administrators of universities face?

(*Dr Edwards*) Yes, I think that is a fair summary, my Lord Chairman.

36. Could we then go on to the actual problems which face some of these people we have touched on a little. What evidence is there on whether you are in fact losing good people because of the temporary nature of appointments, whether if you can keep them on they are less employable in other spheres, and so on?

(*Dr Edwards*) On the question of the terms, again we have anecdotal evidence only. Quite honestly, I do not think the anecdotal evidence leads to a feeling that there is great difficulty in recruiting good candidates for research posts on short-term contracts.

(*Professor Fender*) I think it is fairly evident that individuals are making quite sophisticated calculations about their prospects and, generally speaking, they will take a longer term contract rather than a short-term contract of course. As far as employability is concerned, my impression at my university is that people do find jobs. I would not be satisfied with that; I would want them to have the best possible jobs. This is an extremely important cohort of university staff. We have a responsibility to try to make sure that they get the jobs they would like to have. Only a small fraction of those will be in a university in a traditional teacher/researcher post. I think we are obliged to make sure we are helping them as far as we can.

37. I have heard it said by some employers, but we have no evidence which has been put to us, the longer people stay on in research in universities the less acceptable they become because they get a mind set which makes them unsuitable for employment in the harsh world of industry. Is there any evidence to that effect at the moment?

(*Professor Fender*) No, it is very hard to get evidence. What you do know, is what makes researchers good is that they are passionate about their research, and passion involves single-mindedness which may not always suit another employer.

38. A successful industrial employer actually sets about to engage people by putting in front of them something which they can be passionate about.

(*Professor Fender*) I prefer to see it that way. There is a bit of an obligation on universities to do what they can in the terms to which Lord Phillips referred.

Lord Dixon-Smith

39. Just arising out of this drift in the debate, is there evidence of easy transfer between the world of university research and the world of industrial research, or are they becoming two separate sectors, with separate philosophies and cultures and ne'er the twain shall meet? It does seem to me that in an ideal world there would be a very easy and rapid possibility of transfer between the two sectors and the linkages would be extremely good. We may be at the other end of the spectrum.

(*Dr Edwards*) I think, my Lord Chairman, the answer to that question is there is much more transfer now than there might have been ten or 15 years ago. As we said earlier, the huge increase in the number of contract researchers is largely because of a rapid rise in funding from industry. Certainly from my own personal knowledge, there is no problem in certain subject areas in transferring people from research contracts into industry, and I am thinking of biotechnology, molecular biology and areas of that kind. I have less experience of other fields. It does

[Lord Dixon-Smith *contd.*]

raise a point that we ourselves feel rather uncertain about. We have talked a good deal about the problems of creating long-term careers for those who expect to remain in academic life. A very high proportion of people who are now in short-term contracts are probably going to be well adapted to working outside, and it is probably in the interests of the country that that should happen. This is a relatively new experience for us. Certainly those of us sitting at this table have spent some time in post-doctoral contracts of one sort or another with the expectation of moving into academia, and that is probably what most post-docs did at the time of considerable expansion. We are not very experienced at providing the kind of career guidance that is appropriate for people, some of whom will be doing quite different kinds of jobs.

Chairman

40. On that point, I can recall over 30 years ago when I was in your position, as it were, I introduced the notion of visiting professors from industry to Nottingham, of which we had quite a lot. They were not altogether welcomed by my colleagues at that stage, but I remember vividly a post-doctorate researcher in one department (which I will not specify) saying to me on one occasion that this for him had been a turning point in his career because he had met people who were interesting from outside the university. This brings me to a question: is it desirable and, if so, is it possible to recruit people into universities from industry who will join in the activities of the departments in ways which will make the transition easier for good people to go into industry, and for the general attitude of the department to be slightly leavened by applicability?

(*Dr Edwards*) My feeling is that that kind of transfer is effective but still relatively rare.

(*Professor Fender*) To be blunt about it, the universities are rarely able to recruit at the salary level necessary to attract industrial scientists into universities. To some extent it is less urgent because there are a great many collaborative schemes between universities and industry which actually mix them up in different territories.

(*Professor Bullock*) I think there are two categories: attracting members of staff from industry which is actually very difficult to do, simply because of the differences in salaries; but the other category is the use of visiting professors from industry. I have to say that, in my experience, that has not been so completely successful as one might have hoped. I do not quite know the reason for it. For instance, in several departments in University College there are several visiting professors who come from industry and yet the input they make to departmental activities, and in particular to inspiring young researchers to actually go out and follow careers in industry, has not had the effect one would have liked. I suspect that is probably because departments have not really learned how to use visiting professors properly.

Lord Phillips of Ellesmere

41. I wonder whether our guests would agree that what we are seeing in large part is the consequence of a movement in industry. I sometimes think that the ideal company is the chief executive and his secretary and that is it, and all the other activities of the company are contracted out to whoever can do the work. There is a great movement of that kind certainly going on in industrial research, and universities (whichever way you look at it) are either the victims or the beneficiaries of that process. A very good example is the social science example, Dr Fender's example. There was a time when local authorities employed quite large social science departments which did quite quick studies of this and that; nowadays they do not have such departments but they still want quick contract research done and they hand it out to universities. I wonder whether universities are looking forward to becoming contract research organisations, at least in some areas, and whether they see themselves as being able to organise themselves to do that?

(*Dr Edwards*) I think I would want to say that universities would have to do that. I think it is an important research activity and that universities can do it rather well. I agree that it takes quite substantial amounts of research effort into areas where previously universities had operated more in a scholarly way, rather than in a research team manner.

Chairman

42. It does take a university of a certain size. The model for this is the Stanford Research Institute. This is set up in a State in the United States of America which has a gross domestic product of the size of that of the United Kingdom, and is an outstanding leader. I wonder how many of those kinds of set-ups you can have in this country?

(*Professor Fender*) I can take a much smaller and more homely example. We have a department of criminology which would fit very well with Lord Phillips' general area of interest. Examining that group, which has something like eight academic staff, they get a lot of research income and you will find them doing a whole range of activities, some of which is very basic research in their terms, doing exactly what they want to do, through to quite short, even three-month contracts, for local authorities or other government bodies. The answer is that they can cope very well with that range of different kinds of research. Indeed, the several different objectives of the research interact rather well. I think you could find a lot of examples of that sort. I think that is the main growth area for research in universities of this contract kind.

43. Is this helped by the tendency in universities to establish two or three departmental-level centres for this?

(*Professor Fender*) Yes, exactly.

44. So again we are in an evolving situation, are we?

(*Dr Edwards*) Yes.

[Chairman *contd.*]

45. Perhaps we should go on. I think we have covered questions 3[1] and 4[2], and questions 5[3] and 6[4] were really dealt with earlier on, the question of the discussions with the AUT on the code of conduct and also the new compact. Perhaps we ought to move on to the next page. Is there anything further you want to say on question 7[5]? At the beginning I think you said the hard data were difficult to get?

(*Professor Fender*) We have a lot of hard data. You were asking me earlier to extrapolate into the future rather further than we could do totally reliably.

46. We are allowed to use dotted lines and we can attach such importance to them as we wish. You will send it to us?

(*Dr Edwards*) Yes, certainly.

47. Is there any substance at all in the statement in question 8[6], that contract staff have this argument? We have touched upon it already but it would be nice to get it clear, because this is a matter of concern to them.

(*Dr Edwards*) I think it is not unreasonable that research councils should allow for salary costs at a level which is going to be able to generate the recruitment of sufficiently qualified people to do the research in prospect. I think that is a basic issue which we would not quarrel with. The difficulty is sometimes that the grant has been agreed at a certain level and it is genuinely difficult to recruit somebody at that level, or get substantive agreement. Having always to go back and get approval for a merit promotion, while it is usually successful, does leave in the mind of the researcher the feeling of being a second-class citizen because the run of promotions is done amongst permanent academic staff and is implemented straight away, although there may be some pause. I do not know. I am not sure it is a major problem, is it, Brian?

(*Professor Fender*) I do not think so.

Baroness Hilton of Eggardon

48. The position of women in this very difficult competitive situation may well be worse than that of men, and I wondered if you had any evidence that the present situation which is difficult for everyone is more difficult for women? You might think short-term contracts might suit them, leaving gaps for child rearing, but then it might mean it is more difficult to get the next short-term contract if they do have a gap?

(*Professor Fender*) The proportion of women in short-term contracts is about 30 per cent, so it is higher than the overall figure which is 23 per cent. So in that sense it does support your thesis that it provides opportunities for women. I think one of the difficulties is, particularly in science and engineering, a break can quite quickly move you out of the mainstream. That is why I attach a lot of importance (and unfortunately it is on a very small scale) to schemes like the Daphne Jackson Science Returner scheme which does fund women to come back, pick up perhaps where they left off or even start in a new area, with a view to (after a period of support of two years) their being able to come back fully, mainly into research but it might be they want to be teacher-researchers.

49. What about the proportion within permanent research posts? Is that very, very tiny?

(*Professor Fender*) There are two striking things about women's employment in universities. One is how low it is, and I think the overall figure of 23 per cent is too low. The other striking figure is the rate of increase of women in different levels of seniority, and that is quite astonishing. For example, it is true there are very few women professors but the increase in those professors is 187 per cent from 1988 through to 1993-94.

Baroness Platt of Writtle

50. What is that, three to five or something!

(*Professor Fender*) I thought you might say that! Therefore I want to shift on to the senior lecturers where the increase is something like 80 per cent over the same period of time. No, the total number of women professors is now around 150.

Chairman] To a certain extent this is not surprising, given that you have something like 30-odd years of service before you get to that level of high appointment, and the intake into the undergraduate courses 30 or 35 years ago in many subjects was absolutely minute.

Baroness Hilton of Eggardon

51. I think, Chairman, that is a reasonable excuse in relation to sciences but not in relation to the arts where the proportions are just as poor. I think there is a general problem within universities which one cannot excuse on those grounds entirely.

(*Dr Edwards*) I think, my Lord Chairman, this is an issue which applies not just to short-term contract levels but to all academic staff. If a woman takes a career break for a young family of five to ten years perhaps, there are no easy ways of bringing her back in, and I think we have to think very hard about how we do that.

Baroness Platt of Writtle

52. I would say the most important thing of all, which Professor Fender mentioned earlier, is to have flexible working arrangements so there is not a career

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[1] Has the CVCP any data on the deterrent effect on good possible candidates of temporary appointments?

[2] What percentage of university incomes from all sources is "soft" money? Has it increased over the years and if so is it considered likely that such increases will continue?

[3] Apropos point 7 has the view of contract research staff described in the third sentence any justification?

[4] What progress has been made towards achieving the "new compact" mentioned in point 10.

[5] Is there any bias in the present system against the employment of women. If so, what can be done to make academic research careers as attractive and accessible to women as to men?

[6] It is now over 4 years since the CVCP and AUT formulate its recommendations on Codes of Practice for the employment of research staff on fixed term contracts. To what extent have these recommendations been taken up? Have they been found to be workable, or have they required modifications?

[Baroness Platt of Writtle *contd.*]

break. There are all sorts of ways that can be done. It is difficult because you cannot separate your permanent staff from your research staff but all I would say is that whatever problems there are for women permanent staff they will obviously be exacerbated for research staff because of the lack of continuity you have talked about. I have read the CUCO report that the CVCP produced, which are very interesting in terms of all the statistics provided and obviously that is something that needs to be an on-going policy if these problems are to be overcome. I do not want to talk too much but it ought to include, particularly for scientists and engineers, who as you so rightly said will get out of date if they do not keep up with their subject, things like part-time work as in the Daphne Jackson Scheme, off-site working, job sharing. I was rather depressed to see in the CUCO report that although 95 per cent of universities have equal opportunities policies, only 20 per cent had policies on career development, which is what we are actually talking about. There was a report by, I think, Richard Pearson of the University of Sussex on women radio astronomers—shooting stars he called them—and it did illustrate very clearly that women were very bright in the subject up to first degree level, and up to PhD level, and then they probably married, and then you get this business of perhaps following the husband's job and the wife therefore takes a job which is not exactly suited to her, and then the children come and in no time that parabola goes on downwards. That does seem to me to need to be addressed.

(*Dr Edwards*) Yes, there are a host of problems about the expectations which women have which you have identified. Some of these we can do something about but others are more difficult. Where we can do something about it is where a woman is on a staff appointment, whether a temporary research contract or a permanent post, and has children and wants to take longer than the maternity leave arrangements with young children, we can create the contacts, part-time work, work sharing or whatever, and there is a lot we need to do in that area. I think there are things we can do in those areas which are manageable, whereas persuading someone not to drop out and follow her husband to the States after a PhD in radio astronomy is not quite so easy to achieve.

Baroness Platt of Writtle] The other thing is the age-related salary, because the time when the young, male researcher is really proceeding, the woman is probably having something of a plateau and if she then wants to come back in her 40s the age-related salary operates against her.

Chairman] But there is no age-related salary.

Baroness Platt of Writtle

53. Well I have been told there is.

(*Dr Edwards*) There is not now formally, no.

(*Professor Fender*) But there is still—

Chairman

54. There are forces which tend that way but there is no requirement?

(*Professor Fender*) People look at a scale and they have some expectation about what age people are at certain points on the scale.

(*Dr Edwards*) Universities have much more flexibility now than five or ten years ago about relating points on the scale at which members of staff might be recruited.

Baroness Platt of Writtle

55. That is good. The other thing is that in the minds of senior staff they have normally, in science and engineering researchers' careers and the progression in those fields, seen a male on a 40 year full-time career, and they find it perhaps more difficult to envisage the much more discontinuous career of the woman and may therefore, at a time of promotion, discard the woman candidate because it does not look right in normal career terms. Do you think that happens?

(*Dr Edwards*) I think you have hit on a very significant problem, which is of people's expectations for promotion and what the standard career progression would have been. It would be difficult to pretend that is not a difficulty, but what I think I can say is that each of us has experience of our own institutions but there are many people conscious now of the dangers of that kind of assumption, and that is an important check on it.

(*Professor Fender*) I think there are two encouraging signs. One is indeed anecdotal because Keele is small enough that I can serve on the selection committees for all staff, lecturers as well as senior staff, and there is undoubtedly a change in attitude of the career expectations of women in coming into an academic career in all subjects, not just science, and that is that they have raised their level of expectation much higher. They want to be professors and they want to be professors quite quickly, and in fact you would be very hard put, if you just listened to the words and could not see the person, to discern the difference in ambition between men and women now. That would not have been true ten years ago. The second strand of optimism I have, and it is a bit difficult to put it this way, is that British universities have inherited the collegiate system and that does mean fellows and support staff and a rather big separation between them. The academic body do not really have any elements of human resource management or people management. We share that with other professions which are partnerships, who claim not to need that. The role of women in universities does require not a big bureaucracy from a personnel department but the light touch and the helping hand of departments to develop policies which are much more enabling for the contract researcher or woman.

Baroness Platt of Writtle] And often training.

Lord Phillips of Ellesmere

56. I only want to mention a personal point. I come from a field in which many of you will know a number of women have had very distinguished careers, and I would have said that none of them were people who said, "I will take five or ten years out to

[Lord Phillips of Ellesmere *contd.*]

have my children and try to come back." They all were either well enough off to employ nurses or agitated so that the institution created crèches to look after the children.

(*Professor Fender*) Or found a husband who would stay at home!

Lord Phillips of Ellesmere] Exactly!

Chairman] The most efficient system was the French one, which is the reason why there are always so many women French professors, and that was that granny lived with the family.

Lord Howie of Troon

57. I have been involved in a publishing company, as you probably know, Chairman, and we give women two years' maternity leave, which I thought was a good idea, and most of them take less as it happens. What is the usual maternity leave in universities?

(*Dr Edwards*) I cannot remember what the statutory period is, but we give a lot longer than that.

(*Professor Fender*) It varies enormously. I have a member of staff who has six children and you cannot, in looking at her career, see when she had them—there is no discernible point where you could say she would have had the children. On the other hand, some will take the full time.

58. It is unusual for a university to give more than the statutory period? That is really my question.

(*Dr Edwards*) No.

(*Professor Fender*) I think we are flexible. We cannot afford to hand out longer periods with pay, you understand.

59. I was not thinking of pay, I was thinking of leave.

(*Professor Fender*) If we are talking about unpaid leave, we are almost infinitely flexible.

Chairman

60. Perhaps we ought to move on because time is running out. The last topic is one I know where there is a good deal of divergence of view, or at least variation between subjects. First of all, would you like to tell us whether there is any general attitude of the CVCP? There was in your statement a general welcome for a Master of Research, and yet in my particular field the professional body of the Royal Society of Chemistry and the Chemical Industries Association representing the employers are rather opposed to it. Can you tell us the distillation of your experience in this field and what you are doing about it?

(*Dr Edwards*) There is variation between universities on this. There is a general acceptance of the importance of having an appropriate level of research training at some time for any student who eventually gets a PhD. There are considerable differences in view as to how that might best be done and certainly we are very conscious of the attitudes of employers and the professional scientists which differ considerably from subject to subject. I think now we are interested to see how these pilot schemes work, but I think universities differ a good deal in their attitude and certainly in subjects.

61. In your reply would you touch on the point of a limited sum of money which is available and therefore the Master of Research would be funded at the expense of other activities?

(*Dr Edwards*) This is certainly one of our concerns.

(*Professor Fender*) I think the idea of a pilot would be widely welcomed, not least because the proposals for Master of Research degrees were almost silent on the curriculum. It seems to me that is one of the things which does need to be developed. I think everybody would agree there needs to be an increase of training for graduate students, but there is very much less agreement that it should be concentrated into the first year; it is much better to spread it out. Also the pilot scheme gives an opportunity to identify which are the core topics for any increased training of students.

62. The impression I have from what people have told me and from my life experience is that the one thing a good student after graduation from his first degree wants to do is to get his or her teeth into research. If that is granted, he is quite willing to take on the training which is necessary and in fact eagerly embraces it, but the notion of doing that as a separate activity to prepare one for research later in life in some unspecified field is not an attractive one.

(*Dr Edwards*) My prejudices would be identical to yours.

Chairman] That may be a peculiarly chemical point of view perhaps.

Lord Phillips of Ellesmere] I do not think so, my Lord Chairman. I was party to some of the debates about this issue and that was a major concern within the OST, that good students need to get involved in research immediately as well as being engaged in the training needed to carry out that research. There was a debate about that.

Chairman

63. What is the state of affairs now on the pilot scheme? We shall be seeing the Office of Science and Technology and we shall be hearing what they have to say. How far has it got and how many universities has it touched, if any?

(*Dr Edwards*) It has probably touched quite a few.

(*Professor Bullock*) It has touched University College more than most as a matter of fact.

64. You welcomed it.

(*Professor Bullock*) We did indeed. We did welcome the scheme. We were well set up to provide that kind of training because we have a graduate school which already offers a number of core courses in the research competencies, if I can put it like that, and general transferable skills. With, as you know, the very large breadth of research in University College it was not very difficult to make proposals to give this kind of Masters' training. In fact we did make many proposals and at the moment we know that two research councils have granted us studentships, that is BBSRC and NERC, and at the moment there are four proposals still under discussion with EPSRC. I think the response of the

[Chairman *contd.*]

sector to do it has not been so small as one originally expected. For instance, I believe EPSRC have something like 150 proposals.

65. For the sake of the stenographer would you like to give the full titles?

(*Professor Bullock*) EPSRC is the Engineering and Physical Sciences Research Council and NERC is the Natural Environment Research Council.

(*Dr Edwards*) The BBSRC is the Biotechnology and Biological Sciences Research Council.

(*Professor Bullock*) It was necessary for EPSRC to go into a short-listing operation, which you probably all know about, and we are still significantly involved in that and we expect eventually to participate in at least four of these pilot Research Masters' programmes. It will be interesting to see how they turn out but we believe there will be no problem getting students, otherwise we would not have gone into the pilot scheme, and also we believe, unlike many other institutions, there is a place for this sort of training. The expectation is that about 60 per cent of the Masters' programme will be actually a research project and so, although it will not be the same as doing three year PhD type research, nevertheless the students will be injected very shortly on entry into real research programmes with real researchers who are doing fore-front research. I do not completely agree, from the point of view of University College anyhow, that they will not as it were be involved straight away in real research. It is true it will be a somewhat reduced participation but nevertheless the real research element is a very important, as Lord Phillips knows, specification of the Research Masters' programme. So I think probably we are a little bit out on a limb in welcoming this scheme and in participating so enthusiastically at University College. But the point I have made before, and in fact the point which is made in my submission, is that unfortunately it appears that this kind of initiative is to be at the expense of PhD studentships, and that is something which we do not welcome of course. That seems to me to be a retrograde step, if I can put it no stronger than that.

Lord Craig of Radley

66. Could I explore that particular last point and exactly why you deplore the impact on PhD studentships? Is it just because you believe there should be a large number of those or because you are not confident that the Master of Research is going to be a significantly worthwhile qualification?

(*Professor Bullock*) Not at all. I believe the country does not at the moment train enough PhD students and we should not reduce the number of PhD students to introduce this other qualification, however valid the other qualification will be, or however useful it will be to transfer students from the academic sector into industry. There is still room for training more PhD students. So I feel the overall research student training sector could do with a significant increase rather than actually rearranging, re-shuffling if you like, the kind of training that students seek.

Lord Phillips of Ellesmere

67. Does University College or the CVCP know how many graduate students the country is now training, taking into account the formal graduate students with grants from research councils and also research assistants registered for PhD degrees?

(*Dr Edwards*) I do not know the figures off the top of my head.

Lord Craig of Radley

68. Just picking you up on your point that we are not training enough PhDs nationally, there is also the point made in the CVCP submission that there are almost always sufficient candidates to make an appointment. That may not be directly related but I get the impression there is not a shortage.

(*Professor Bullock*) There is not a shortage to recruit into universities, but I was talking about nationally the number of PhDs. I think I am quoting the right evidence but I believe industry has already suggested that there should be more PhDs trained—I think that is right although I am not completely sure.

Lord Craig of Radley] Could you find that particular piece of information and let us have it? Would that be helpful, my Lord Chairman?

Chairman

69. Yes.

(*Professor Bullock*) I am not sure whether my colleagues can substantiate that statement but I am pretty sure that is right.

70. It is perfectly open for an individual to send something in at variance with what might be described as the party line if you wish to do so!

(*Professor Bullock*) I feel a little apprehensive because I only received these papers at 9.30 this morning, so I may not be following the party line. I am sure that is a very good thing!

71. It is just 41 years since I started post-graduate research training in the University of Leeds in physical chemistry, and I know I was not alone in that, and it was based on American experience and modified because those of us who had had experience of America felt that the inordinately long period which they took was a mind-quencher rather than a mind-liberator. That is a statement rather than a question, sorry!

Lord Howie of Troon

72. I wonder if Professor Bullock could clear up a very small point I had? At the end of his comments on the Master of Research degree he says that you need something like seven years to go from 'A' level to PhD, and then he suggests that that could be broken up into 3 + 1 + 3 years or 4 + 3 years or even 1 + 3 + 3 years. Could he tell us what these numbers mean?

(*Professor Bullock*) Of course. Thank you for giving me the opportunity to do so. The normal time period for United Kingdom students to graduate with a BSc or BA is three years. It is not the same in all disciplines but by and large that is what it is.

[Lord Howie of Troon *contd.*]

Chairman] Lord Howie comes from Scotland, I should say!

Lord Howie of Troon

73. I understand the indiscipline of the English!

(*Professor Bullock*) I am sorry to be such a Sassenach! Within the sector which you and I understand we are talking about, the normal time is three years. The normal funding for post-graduate students taking a PhD is three years, so the normal time is six years. In many disciplines, and it may be all disciplines, the fact that the pre-university education has changed from being directed towards increased breadth rather than just simply depth has meant that many under-graduate curricula have had to take this into account by providing, or wanting to provide—at the moment not many of them do—an extra under-graduate year, giving four years, so those students can be brought to the level at which they can successfully embark on a PhD. That is one solution and that is the solution which has been taken by the physicists and over the country now the physics degree which you would expect to lead to research is four years; there is still a three year BSc in physics but a large percentage of students will be taking four year degrees. That is not the only solution, however, but it is a solution which happens to apply particularly in physics. Another solution would be for a normal three year under-graduate degree, a one year Master's degree and in particular a Research Master's degree, followed then by three years in research. That is what I mean by 3+1+3. That indeed would be nice, if research funding bodies would fund students who already had a Research Masters to go on to PhD status. The other possibility is simply to accept the fact that in some disciplines again pre-university students are insufficiently accomplished to embark on an under-graduate degree and provide for them an initial foundation year. Once upon a time we used to call that an intermediate degree or something like that, but that is another possibility and that would amount to the 1+3+3. But whichever way you look at it, it requires one year's extra funding.

Chairman

74. Whatever way you look at it, the cost of producing a graduate has increased?

(*Professor Bullock*) Yes.

Lord Renwick

75. Could you explain the Brunel-type sandwich course to us? I understand it is a very successful university in getting people into employment with industry, rather than perhaps going on to PhD research.

(*Professor Bullock*) I think that type of degree is very much to be applauded. We do not run any at University College. The meaning of sandwich is that they do a certain amount of their training in the university and a certain amount of training in the industry concerned. Those two are hopefully knitted together in a rather seamless way so it is a coherent programme of study. I have no personal experience of running such a system, but I believe that it is an extraordinarily good way of producing people for industry. I would say there is another way, which I have also mentioned in my submission, and that is that I think industry could well do a lot more towards providing student bursaries, both at under-graduate and post-graduate level. Our experience is that those few students who manage to get industrial bursaries, and who then get a slightly higher maintenance allowance which is welcome, actually love working in industry in their vacation. The reason they love it is because they think, and in most cases it is true, they will get permanent employment in that industry; many of them do. We have very few who have industrial bursaries but for the majority who do have them their first employment is very often with that particular industry. I think, to be perfectly honest, industry is missing a golden chance.

Chairman

76. I think we are getting a little far away from our main theme and perhaps the time has come to draw it to a close. Before we do that, are there any other points to which you would like to draw our attention which we have not touched on this morning?

(*Professor Fender*) I was anxious to give the Lord Chairman a hard fact before he closed. The number of PhDs in 1993-94 awarded for the country as a whole, the United Kingdom, was 8,717. The largest single discipline was chemistry with 818; fine art was one. I think that perhaps makes the point which was being made over here, that the chemistry industry is surely one of the most successful parts of British industry and it is very much fuelled by these 818 PhD students per year, many of whom are going into that industry. A reduction in that number, which was the point of the discussion, because of the introduction of the MRes would not be a good thing. So if we are to introduce MRes let us do it in addition.

77. And would not be welcomed by the industry, I am told.

(*Professor Fender*) I am sure.

78. Thank you very much indeed for coming. We are most grateful.

(*Dr Edwards*) Thank you for the opportunity, Lord Chairman.

TUESDAY 31 JANUARY 1995

Present:

Craig of Radley, L.	Hilton of Eggardon, B.
Dainton, L. (Chairman)	Howie of Troon, L.
Dixon-Smith, L.	Phillips of Ellesmere, L.
Haskel, L.	Redesdale, L.
	Renwick, L.

Memorandum by the Office of Science and Technology

SUMMARY

1. The Government believes that steps can and should be taken by the university employers and the bodies which fund university research by project and programme grants, including the Research Councils, to address acknowledged problems in the management of contract research staff by universities, without creating a self-defeating expectation that more than a small proportion of such staff can expect a long-term career, especially research only, in universities. This evidence reviews the backround, summarises the recommendations in the White Paper "Realising Our Potential: A Strategy for Science, Engineering and Technology", and outlines work in hand.

Q1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

2. In 1993 there were some 56,000 full-time academic staff in UK universities[1]. The traditional academic career, especially in the natural sciences, comprises a doctorate, a post-doctoral research assistantship or fellowship, and a permanent academic post, generally wholly funded by the university and involving teaching as well as research. In 1993 there were about 35,500 full-time academic staff so supported.

3. Since the 1970s there has been strong growth in university research funded on fixed-term grants or contracts. This has led to a pattern of employment in which the research is carried out by staff employed by the university on fixed-term contracts. In 1993 there were some 18,600 such staff.

4. The universities are responsible for determining and meeting their staffing needs, the balance between permanent staff and those on fixed-term contracts, terms and conditions of employment, and staff management and development.

5. Under the "dual support" system, universities receive public funds for research through both institutional funding from the Higher Education Funding Councils, and project or programme grants from the Research Councils and other funding bodies. This gives universities a desirable discretion to determine their own priorities. It enables them to maintain a permanent research capability whilst also providing for flexibility, novelty, and responsiveness to the needs of research users. Nonetheless, the employment of increased numbers of contract research staff by universities has led to tensions, acknowledged and addressed in "Realising Our Potential".

6. The Government believes that progress should be made to resolve those tensions, but without creating the artificial expectation, especially among research students and postdoctoral research assistants, of a permanent career in academic research, when the strengths of the system as a whole depend on this being realistic only for a minority.

Q2. *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

7. USR data indicates that income to univerities from research grants and contracts—provided by the Research Councils, Government Departments, research charities and industry—has increased by over 500 per cent between 1979–80 and 1992–93. This growth of an academic market has successfully brought together different customers for high-quality research with the universities and their staff as key suppliers of advanced knowledge and know-how.

8. Funding university research by project and programme grants enables funding bodies, such as the Research Councils, to foster new research and new talent, to target their resources on their top priorities, and to switch those resources flexibly in the light of new demands and developments. It provides for a continued supply of fresh ideas and energy into the science and engineering base. It gives academic staff the opportunity

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[1] Universities covered by the Universities' Statistical Record (USR) only. The evidence in this submission focuses on contract research staff within these universities.

to seek support from a range of funding bodies both within the "dual support" system and more generally. The fixed term of the grant encourages efficient time and resource management.

9. Those employed by universities on fixed-term contracts to carry out the research can acquire initial research training (though this may not always be the best route to do so); test their suitability for research inside or outside academia; contribute significantly, especially at the post-doctoral level, to a research project; switch projects; and in general gain a wider range of experience. Some contract staff value the flexibility and freedom of contract research work.

10. However, there are disadvantages. Time, effort and money are expended in applying for research grants and, if successful, in recruiting and training contract staff who may then leave before the project is concluded to take up some other post. The primary focus of the project is to produce research output; contract research employees may be regarded only as pairs of hands used to achieve that end, and not as staff to be actively managed and developed.

11. Those who seek employment on a succession of short-term contracts may face terms and conditions which do not always compare with those of permanent staff inside or outside academia, little prospect of career progression, and a growing risk, not least in their own minds, of unsuitability for alternative work. That may deter some potential research leaders from pursuing a career. On the other hand, many contract research staff do aspire to long-term or permanent careers in universities[2], even though it may not be in anyone's interest to prolong this pattern of employment unduly when the prospects of a permanent post in academia are small and the individual's talents and experience may be better utilised elsewhere.

Q3. *How do you expect the situation to change in the next decade? (Please bear in mind, among other factors, the current age structure in full-time university posts and expected changes in university income levels and sources.)*

12. "Realising Our Potential" acknowledged the need to improve career management of contract research staff irrespective of the numbers in universities now or in the future. The White Paper made recommendations to secure such improvements.

13. A key step is to provide better advice to contract research staff which makes clear the limited opportunities in academia and the possibility of alternative career paths.

14. The Research Councils, and the Royal Society, share a common interest with the universities in identifying the minority who show research leader potential, and ensuring that career openings exist for them in academic research. Many other staff may be better advised to leave academic research after a doctorate or initial period of post-doctoral research for employment in industry, commerce or the wider public sector. University employers also need to decide whether they wish to provide structured career development for a limited number of contract staff who, though not research leaders, have proven their capacity to make a significant contribution over the longer-term, and if so how to fund them. Advice to the individual concerned is likely to depend not only on his or her potential, but on the nature of the research in question and the views of funding bodies on whether the costs of such support, as reflected in project or programme grants or other forms of support, represent good value for money.

15. The Research Councils are major funders of research projects in universities. They also have a responsibility to meet the need for trained scientists and engineers in the science and engineering base itself, in industry, and elsewhere. They therefore have an interest in working with the employer universities to ensure that contract research staff receive good career management and advice.

16. "Realising Our Potential" identified two main objectives:

(i) the Research Councils should have arrangements to ensure that university employers are providing proper career management and advice for contract research staff;

(ii) the Research Councils' grant-making arrangements should help the universities discharge those responsibilities, and the Councils should look at the scope to put greater emphasis on longer-term or more personal forms of research support, such as fellowships to ensure that there are adequate openings.

17. The Research Councils, in consultation with the Royal Society and the OST, have been considering how best to meet the first objective. The Councils believe that it would be helpful if they defined their own, collective expectations—in terms of principles rather than detailed specifications—for the management of contract research staff by university employers. They intend to approach university representatives with draft proposals in the near future.

18. The Medical Research Council has already taken steps through a range of measures including new career development and fellowship awards to meet the second objective. The other Councils, including the three new Councils established in April 1994, are also developing their policies. For example, the

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[2] A Survey of Contract Research Staff in UK Universities, C Bryson and E Tulle-Winton on behalf of the AUT, Autumn 1994, page 10.

Biotechnology and Biological Sciences Research Council intends to increase the number of fellowships and volume of longer-term research grant funding. The Engineering and Physical Sciences Research Council is planning increases in fellowships and studentships in order to achieve a better balance in its portfolio of different types of support for skill development; some studentship awards will be funded as an alternative to research assistantships on research grants.

19. The Royal Society has received extra funding from the OPSS science budget to increase the number of its University Research Fellows from 200 to 240.

20. Other funding bodies, such as the research charities, also have important roles to play to ensure that adequate career openings exist to sustain research excellence. The Wellcome Trust has instituted a programme of career support for high-calibre research scientists comprising staged fellowships.

21. It is the universities, however, who are primarily responsible for determining and meeting their own staffing needs. The Government welcomes the recent decision by the University of Warwick to fund 50 new research fellowships from its own resources.

22. The Funding Councils have an interest in reviewing overall numbers of academic staff in order to aid assessment of the Higher Education sector's ability to carry out its functions.

23. The Scottish Higher Education Funding Councils decided, after consultation with the institutions it funds, to set aside £10 million in 1994–95 to fund the early retirement of about 300 full-time academic staff and their replacement by younger staff. It is anticipated that the scheme will help significantly to redress the age profile problem in higher education institutions identified by the Committee of Scottish Higher Education Principals and others.

24. The former University Grants Committee (UGC) ran two schemes which aimed to change some aspect of the age profile of staff within institutions[3]. Neither scheme was aimed specifically at the problems of staff on short-term contracts, although both may have enabled a number of staff to make the transfer from such contracts to permanent employment. The Higher Education Funding Council for England is currently conducting a review of the age structure of academic staff which will cover the impact of various restructuring schemes funded by its predecessor Councils and others.

Q4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

25. The USR staff record gives data on the destinations of contract staff, but "the figures are of limited value because of the high proportion (about half) classified as going to 'other (in UK)'"[4]. Systematic data is not available for the ex-PCFC sector. Two recent studies by the Science and Engineering Research Council[5] indicate that perhaps 40–50 per cent of SERC-funded research assistants go into industry, commerce or the public sector and the rest stay in higher education.

26. The OST is currently awaiting the results of a study into the feasibility of tracking the careers of several cohorts of postgraduates retrospectively. If it is feasible, this is likely to yield useful information on the careers of post-doctoral research assistants.

Q5. *What should be done to improve the mobility of scientists between academia and industry?*

27. Many of the key policies in "Realising Our Potential", such as the Technology Foresight Programme and the new Research Councils and their missions, are intended to help bring about a culture change which will facilitate greater interaction—and the mobility which flows from it—between the science and engineering base and the users of research and trained manpower in industry, commerce and elsewhere.

28. There are many kinds of mobility. Some scientists leave permanent academic posts for industry, commerce, or the wider public sector, and vice versa. Data from the USR suggests that the flows are small, and that the flow into academia exceeds the flow out.

29. Mobility is also provided by secondments and visiting fellowships or professorships, and is implicit in collaborative research and collaborative postgraduate training, especially where this involves employees and students working off-site or off-campus.

30. The Government believes that postgraduate research students should acquire experience and skills during training which will open up opportunities for them both inside and outside academia. "Realising Our Potential" set out the Government's policies to improve the quality and breadth of postgraduate training.

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[3] The "New Blood" appointment scheme in 1983, and the New Academic Appointments Scheme which ran for five years from August 1989.

[4] An Anatomy of Research Personnel in UK Universities by Harry Atkinson, Richard Bond and Patricia Mullins, SERC, 1992, page 48.

[5] A Study of Research Assistants Supported by SERC Grants, PREST, 1992, and An Evaluation of the Benefits of SERC Postdoctoral Fellowships, Policy Study No 4. The responsibilities of the SERC were taken over from 1 April 1994 by the Engineering and Physical Sciences, Particle Physics and Astronomy and other Research Councils.

There is also scope to encourage more positive mobility of contract research staff between academia and other sectors of employment, making this part and parcel of the career management and advice which staff receive from university employers. The Research Councils are considering whether they might use specific grant mechanisms to encourage such development.

31. The Government and funding bodies have sponsored many specific initiatives to promote mobility: e.g. the Senior Academics into Industry Scheme; the Royal Society/EPSRC Industrial Fellowships; fellowships and professorships sponsored by the Royal Academy of Engineering; LINK; the Teaching Company Scheme; CASE studentships (co-operative awards in science and engineering); Postgraduate Training Partnerships; the 4-year Engineering Doctorate; and now the pilot research Master's degree.

Q6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

32. The Government expects the situation to improve over the next decade. It recognises that the number of women in scientific careers is lower than would be expected, and is taking positive action to address this.

33. In "Realising Our Potential" the Government acknowledged the potential loss to the nation if women were not encouraged into science, engineering and technology, and emphasised its desire for change. It appointed a committee of experts to review the position and to produce a set of recommendations. In its response to the committee's report, "The Rising Tide"[6], the Government accepted many of the recommendations, including the creation of a Development Unit on Women in Science, Engineering and Technology to take forward agreed recommendations. This unit was established within the Office of Science and Technology on 5 December 1994. A copy of its remit is attached.

34. A good basis for improving the number of women in science, engineering and technology has been laid by the National Curriculum in England and Wales which has made science, maths and technology obligatory for girls and boys to age 16. The proportion of girls taking and gaining good grades in science and maths at GCSE is now slightly higher than that of boys. The Government hopes that more girls will be encouraged to study science and maths after GCSE. It will also take steps to ensure that girls and women have adequate access to careers advice on opportunities in science, engineering and technology.

35. The provision of education in Scotland is not statutorily prescribed, but the Secretary of State issues guidance to education authorities, based on advice from HM Inspectorate of Schools and the Scottish Consultative Council on the Curriculum. The Council issued guidance on equal opportunities in 1987 and 1993 which encourages the active promotion of equal opportunities in all school activities and equal access to all subjects of the curriculum. Generally, the take-up of maths and science at Higher Grade has shown a steady increase over the last four years, even though there was a decrease in the S5 and S6 population. Girls are making good progress and do better than boys in Higher Grade maths and physics.

36. However, formal education can only be part of the solution. It is important to stimulate the enthusiasm of girls and boys for science. The Government has contributed to the impact of many successful existing initiatives, such as Women Into Science and Engineering (WISE), through its Public Understanding of Science Campaign, and will continue to do so.

37. The Government welcomes the work of Opportunity 2000 and its members (including over 30 universities) towards a better balanced workforce. There is a wide range of measures which employers can adopt, including flexible working arrangements and career breaks. The Government will be seeking to encourage employers to implement employment policies and practices which are friendly to women with family commitments. This will include employers of female scientists in academic research.

38. The Government welcomes work by the CVCP and its Commission on University Career Opportunity to highlight the importance of equal opportunities and to disseminate good practice. The Government's response to "The Rising Tide" gave details of the parallel steps being taken by the Research Councils and Royal Society in their role as employers of scientists in research institutes or as funders of research fellowships.

39. Contract research work in universities may deter some women from pursuing a research career of any kind, or from remaining in research as a long-term career. According to USR data, more men are in wholly university-funded academic posts than in posts not so funded, but the opposite is true for women. Aside from the problems and remedies already described, there is evidence, for example from the recent AUT-sponsored survey[7], that while in some universities women enjoy maternity leave and benefits which are comparable to those of permanent staff, in others they do not.

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[6] The Rising Tide. A Report on Women in Science, Engineering and Technology, HMSO, 1994; and the Government's response, Women in Science, Engineering and Technology, HMSO, 1994.

[7] See note 2 above.

40. The Research Councils intend to encourage all universities in receipt of Council grants to adopt comparability with provision for permanent staff as a minimum standard. They also intend to fund certain costs arising from extension of a research grant because of maternity leave, in particular employment of a support worker to keep the woman concerned in touch with the research.

Q7. *The Government's Master of Research Degree (MRes) will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

41. The pilot is intended to test the degree's effectiveness as a direct route into employment as well as a preparation for the PhD. The Research Councils are working with interested universities and employers to support about 250 students on research Master's courses from autumn 1995.

42. The Government's decision[8] to ask the Councils to press ahead with a pilot followed extensive consultation. This revealed firm support for the degree from a number of academics and employers.

43. The Government concluded that the degree should not be a prerequisite for pursuing a PhD. It believes, however, that the degree should open up to those students who take it the possibility of a research career outside academia either immediately or at some later stage following a further period of research training; it should also better prepare them for that opportunity.

Examination of Witnesses

SIR JOHN CADOGAN, Director-General of Research Councils, MR DAVID WILKINSON, Head of Science and Engineering Base Group, MR DEREK BARKER, Head of Research Management and Manpower Policy Division, MRS LYNDA SHARP, Head of OST Development Unit on Women in Science, Engineering and Technology, called in and examined.

Chairman

79. Good morning, Sir John and colleagues. Thank you very much for coming and thank you also for your memorandum. It is customary on these occasions to invite you to say anything you would like to say at the outset, but may I just break with tradition a little bit because there is a piece of information in your memorandum which I really would like to have clarified and that refers to paragraph 7 on page 2 where it states: "USR data indicate that income to universities from research grants and contracts . . . has increased by over 500 per cent between 1979-80 and 1992-93", which I take to mean a sixfold increase. Is that right arithmetically?

(*Mr Wilkinson*) Yes, that is correct.

80. But in real terms it has no such significance and that is what we really want and there the increase by my calculation is a mere 170 per cent or 160 because of inflation. If one also takes account of the general rise in salaries then that is not so large as you might think. Would you agree with that?

(*Mr Wilkinson*) I would agree that the real-terms increase is indeed not sixfold[1]. Perhaps the main purpose of the figuring in paragraph 7, my Lord Chairman, is that in 1979-80 the USR figure for such income was 13 per cent of the university's total recurrent income and by 1992-93 it had risen to just over 20 per cent of the university income, so our purpose was in many ways not to suggest a real-terms increase but to indicate the change in the balance of income from recurrent grant to earned income from contracts.

Chairman] Thank you very much. By the same token, of course, one can look at the staff increase in that time and the contract staff and that corresponds with 130 per cent which makes the increase in salaries look much more reasonable.

Lord Howie of Troon

81. If that was in fact your intention then why did you put it this way?

1 (*Sir John Cadogan*) I suppose the answer must be, my Lord Chairman, that nobody is perfect. There is no intent to try to mislead. It is a question of taking the figures as they are and reporting them.

Chairman

82. Did you mean perfect or numerate?

(*Sir John Cadogan*) I do not think this is innumerate. It is correct within the parameters that you describe.

83. Thank you very much. Is there something you would like to say by way of general introduction?

(*Sir John Cadogan*) My Lord Chairman, thank you for inviting us. Perhaps I should begin with introductions: David Wilkinson is Head of the Science and Engineering Base Group in OST; Mr Derek Barker is Head of the Research Management and Manpower Policy Division, and on my far right we have Mrs Lynda Sharp who was newly appointed just a couple of months ago to Head the new Development Unit on Women in Science, Engineering and Technology. We are very pleased to be here and we are glad indeed, if I may say so, that your Sub-Committee is looking at this extremely important topic because it is very important. It is not only important, it is complex and Lord Phillips will know better than I that this has been something that people have been grappling with for many years. ABRC had a big input into the recent White Paper

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[1] It is 165 per cent, using the GDP deflator.

[8] "Research Councils to pilot new one-year Master's courses for research students", OPSS Press Release 211/94, 26 October 1994.

[Chairman *contd.*]

"Realising our Potential" and that reflects their advice. It has been a big issue and a worrying one. Perhaps I could just say where we have got to. The White Paper listed some 17 objectives for my group and I am glad to say that most of them have been accomplished since the White Paper was published and some of these objectives are indeed career related. Very early on a recommendation was made to the Chancellor about the Royal Society and its University Research Fellowships, which are these splendid fellowships which run for five years to create an opportunity for top-class scientists to stay in science and help to extend their career. In the first month of my appointment we recommended that those fellowships should be significantly increased from 200 to 240. This was one of the first objectives we achieved. We also carried out a very extensive consultation process with the community, both academic, user, industry and government departments on the question of the Research Master's degree, which of course is a career orientated activity. Recommendations were made, as you know, and these were accepted and we believe that it is fair to say that overall this has been generally acceptable to the community out there as a good step forward. The Chancellor asked a group to study the question of women in science and technology, or rather the lack of women, and they published, if you recall, a paper called "Rising Tide" and as a result of this the Government responded by setting up the Development Unit of which Mrs Sharp is the first head. Again this is a step forward. The remaining major objective which has not yet been achieved is the question of a career structure for short-term staff in the universities, which of course is really quite complex. This is not in the "unachieved" bracket because we consider it unimportant or indeed too difficult; it is just that it takes rather a long time. I was actually charged in the White Paper to carry out an extensive consultation with the Research Councils, with the Royal Society and with the universities to produce a concordat for this issue because, as the White Paper observed and as the ABRC observed before us some five or six years ago, there are serious management issues as to whether indeed people on short-term contracts are being properly looked after, whose fault is it, is it anybody's particular fault or is it a combination of difficult circumstances? I am glad to report that we are very well on with this and Mr Barker has the responsibility for taking it forward. We have indeed got to the stage where we have a paper which is acceptable to all six Research Councils and the Royal Society. That is, seven very independent bodies. As one Chief Executive said to me, "We have been trying to get this for five years and at last we have got it." We are now in the process of talking this over with the Committee of Vice Chancellors and Principals. I am confident that we will come up with a concordat which will be very helpful and this will be taken up by Sir William Stewart's Science and Engineering Base Coordinating Committee on 6 March. Though we have not concluded it in the first year, I hope that we are pretty close to a reasonable solution. I would not dare suggest it is a perfect solution. Thank you.

84. When the universities were here before us a week ago they told us that they had achieved a kind of compact with the AUT on this matter. I imagine that your arrangement by virtue of being with the universities would also take account of that?

(*Sir John Cadogan*) We certainly have been talking to the AUT.

(*Mr Barker*) Yes, my Lord Chairman, that is correct. I think the concordat that they were referring to must be one of perhaps three or so years ago[2]. We are of course building on foundations which are already in place.

85. So it is really a matter for them of trying to manage their resources to bring this into a proper arrangement systematically. At the same time, as they said to us, they have certain perceptions about the funding from the Research Councils to enable them to do that. All these are questions down on our paper so perhaps it might be worthwhile just trying to work through them, if you would agree. First of all, the current and future trends. This is something which really does worry us; namely, we feel uncertain about the question, which the universities were not very clear about, as to whether there is not a self-righting factor here in that there is an age profile which is moving up through the system because of a lack of a new entrants at the lower end and therefore that means that there will be tumbling off at the age of retirement a considerable number of people creating vacancies as the peak moves towards the end. Has your department looked at this particular problem and is what I am saying untrue?

(*Mr Barker*) The expectation, my Lord Chairman, is that indeed much of the sixties' bulge of tenured academic staff will be moving out of the system perhaps over the next ten to 15 years and, therefore, in principle one might expect that that would create some opportunities for staff who are at the moment on fixed-term contracts to move into some of those places. There may be some sign that this is already starting to happen which is encouraging, but, on the other hand, it is simply a factor of life in the late 20th century that employment generally has tended to acquire quite a significant fixed-term dimension and I would expect that this would apply to the universities sector as indeed elsewhere.

86. When we asked Professor Fender last week he said that there was a countervailing factor in that the contract staff were increasing at six per cent per annum. Have you also noticed this?

(*Mr Barker*) Yes, my Lord Chairman. The fixed-term staff have really been increasing over the last few years, that is certainly true, but of course not all the fixed-term staff will or indeed want to acquire permanent employment with the university system. Many do move out to other sorts of employment.

87. And the question is back to the central question you raised as to how to manage them best, is it not?

(*Mr Barker*) Correct.

88. There is, in a sense, a kind of response to that in your paragraph 25 where you say that the figures are of limited value because a high proportion are classified as going on to "other". I understand, however, that in fact the data which are available to you specify whether these people are going, for

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[2] It was signed in October 1990.

[Chairman *contd.*]

example, abroad or retiring or going into industry and I think that would be very interesting for us to draw out. Could you confirm whether that is the case? Everyone would applaud the fact that good people were going into industry carrying, as it were, ideas on the hoof. One would be worried if a large proportion of them were going abroad permanently.

(*Mr Barker*) My Lord Chairman, I have some data on the first destinations of Research Council research students finishing their studentships in 1992.

89. Yes, but I am thinking really of those who are in the contract research staff post-doctoral.

(*Mr Barker*) Right.

(*Sir John Cadogan*) We are still trying to track these. It is extremely difficult and we have a study in hand to try and track these.

90. When is that likely to be completed?

(*Sir John Cadogan*) I do not know the answer to that.

(*Mr Barker*) It is a feasibility study to assess whether it is, indeed, practicable to do it and we expect that to report in a couple of months[3].

91. You would agree, I imagine, that it is important to know who gets the benefit of the training which these people have received?

(*Sir John Cadogan*) Indeed.

Lord Howie of Troon

92. Paragraph 25 says that 40 or 50 per cent of research assistants go into industry or elsewhere. Paragraph 28 says that data from the USR suggests that the flows are small and that the flow into academia exceeds the flow out. Have I just misunderstood these two? I think there is a difference, is there not?

(*Mr Wilkinson*) I think, Lord Howie, there is just a category difference. In 25 we are dealing with people on fixed-term contracts and then in 28 we have moved on to academics.

Lord Phillips of Ellesmere

93. While we are talking about current and future trends, I notice that in the paper the Office says that its statistics relate only to the old university system and not to the ex-polytechnics, so to speak. Are you doing anything about acquiring information on that front? I am aware of numbers of new universities who are attempting to build up their research strength. Do you know how many opportunities are arising for contract workers in those universities, what the numbers are, if you like, which relate to the numbers in paragraphs 2 and 3?

(*Sir John Cadogan*) My colleagues will know the numbers better than I, Lord Phillips, but clearly this is a big opportunity for getting lots of data. We are conscious that it is a major issue with some extra 80 institutions, many of whom have significant ambitions on the research side, and this is something that we must master. We have not got it yet, but I stand to be corrected.

(*Mr Wilkinson*) I think as an Office, Lord Phillips, we are not making any special efforts ourselves because, as the USR combines to bring in the new universities, then the figures will be forthcoming as part of that[4]. But I do agree that in terms of opportunities and broadening the supply this is obviously something that we should take very seriously.

Chairman

94. We have heard from HEFC England that, whilst they are not giving us evidence, they are working on the report and I think you refer to it in your document. They are trying to produce some data themselves. Since this is so central to our enquiry, when we get on a little further as we begin to find some information which is of value ourselves, perhaps we could come back to you in the Office and share it and compare it with your information?

(*Sir John Cadogan*) Thank you very much.

Chairman] Are there any other points which anyone would like to raise on the first three questions? If not, perhaps we could come on to the general question of career management. Lord Dixon-Smith?

Lord Dixon-Smith

95. Sir John, paragraph 12 of your memorandum acknowledges the need to improve career management for contract research staff irrespective of the numbers in universities now or in the future. This is a serious question. Has career management been neglected in academia in the past, and if so, who is responsible for changing it? And I think I could tack on to the back of that question, partly as a result of our interviews with the representatives of the CVCP last week, it appears that academia does not realise what a wonderful business opportunity is created and I wonder whether it is managing it at all?

(*Sir John Cadogan*) I do not think there has been any neglect. I think it has been an expanding problem, indeed an expanding opportunity, which has perhaps overwhelmed our colleagues sometimes because the numbers coming into this sector are very large. It is for the research councils to play their part, certainly for the whole of the new university sector to play its part, and it is precisely on these issues that Mr Barker's group has been working so hard. I believe that we have made considerable progress, though I would hope you would not press me on any detail at this stage because we are still discussing this with the universities.

96. We have read what you said about the concordat which you hoped would develop.

(*Sir John Cadogan*) This is precisely the issue which is at stake.

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[3] See paragraph 26 of OST's written evidence. If it is feasible to track postgraduates, this is likely to yield data on those proceeding to postdoctoral research.

[4] The Higher Education Statistics Agency will begin publishing data for all the universities this year. The academic staff of polytechnics and colleges 1991-92, HEFCE, July 1994, gives 1,899 externally-funded staff in institutes funded by the former PCFC in December 1992.

[Lord Dixon-Smith *contd.*]

97. But tacitly this has not really been tackled with any particular energy in the past, although it is obviously being tackled with some enthusiasm now?

(*Sir John Cadogan*) It is not for me to say whether it is being tackled with great energy. I suspect a lot of people have been extremely concerned about it. I believe that the consolidated advice, including that from ABRC, which was brought forward in the White Paper, has produced a clear focus and, indeed, an objective which has been laid down as part of government policy, and that really does concentrate the mind. The White Paper says, "This is important. These are the issues. Please solve them." I do not think that had been done before.

Lord Phillips of Ellesmere

98. I wonder, Sir John, is not the problem that it is all very well for the Office of Science and Technology in the White Paper to lay out what are the criteria for good personnel management of these contract research staff? Indeed, the CVCP also produced a paper under the chairmanship of Brian Fender which set out the kind of criteria that were needed in managing these staff, but the responsibility for something happening really lies with individual universities. They will only move, I would imagine, if there is some kind of pressure on them to make them move, and that suggests that research councils and other agencies ought to be applying conditions to their grants that insist on particular bits of apparatus being in place. That, indeed, is implied in the White Paper. I wonder whether the agreement that you are arriving at will actually cover that?

(*Sir John Cadogan*) You have described the situation perfectly, Lord Phillips. There are so many individual organisations, most of them with royal charters, jealously guarded independence, who have to be brought together to agree on the best set of solutions. I do not think there is one solution. The research councils are a very important part of that because they provide a great deal of the money, not all of it, of course. We have the charities, some of whom are very wealthy; they have a say in it. Of course, if this is to work then there must be some very hard stipulations produced and I would expect the research councils, the universities, the charities and the Royal Society to take all this into account. But I agree with you, otherwise it will not be a hard and fast binding solution.

Chairman

99. In this context I think it is perhaps fair to ask whether the position has not arisen because until the end of the Seventies at any rate the growth in student numbers carried with it a corresponding rise in the income of the universities and, of course, you see that no longer followed throughout the Eighties, and this is witnessed by the fact that the number of whole-time university staff paid from university sources has remained static. Therefore, the problem that we were discussing earlier of the aging population of staff also carries with it the fact that the universities have had to think for the first time that there is not a normal progression within the academic staff. That must be our first consideration and they have, I think, neglected the contract staff, who are growing. But in this context—I mention it particularly—is the question as to whether the research activity should not be on a par from the point of view of terms and conditions of service with research and teaching activity; in other words, there is a gap between those two groups and in particular it is noticeable, coming on to the next question really, that the women in the research contract group are all in the lower-paid sort of groups and that is a source of considerably worry.

(*Sir John Cadogan*) I agree, yes, indeed, and, of course, Mrs Sharp has already picked this up.

100. I did not see it in here. Did I miss it?

(*Mrs Sharp*) No, my Lord Chairman. I have to say I am encouraged, coming into the Women's Unit, to see the progress which appears to be being made by the research councils towards putting together this set of expectations for contract staff. I am encouraged that many of the ideals I see in there will be to the benefit of women employees if they are implemented by the universities.

Baroness Hilton of Eggardon

101. Can I pursue the role of the research councils in imposing some sort of career management on universities? Would it be fair to say that the research councils' main concern has been with ensuring that decent science was carried out by the people to whom they gave grant and perhaps they were less concerned about the human resources where at the moment, at least anecdotally—and I have university friends who tell me this—people carry out a short-term contract on some piece of research and a lot of people are going out not only of the university world but out of industry. They are not taking their science skills into industry or abroad or anything; they are totally going out of the whole science world, and this is not only a waste of young individual scientists but it is also a waste of money in training them and a waste in the sense of the money spent on research grants and so on. So the main point I am making is, should not the research councils have as a large part of their programme, what they are thinking about when they are giving grants, the actual career development of the young scientists?

(*Sir John Cadogan*) This is a particularly complex issue. The research councils are charged to carry out their mission, which is to get the best possible science in the areas that they so decide, guided by whatsoever. They do this as far as staffing is concerned in two ways. They might well have their own institutes or units which are run directly by the councils, and in there, of course, the research councils are directly responsible for career progression, for advice, for promotions, for everything else that you can think of, and there I believe the research councils have a very good record. You will have seen their own submissions. The other side of it is that a great deal of the money goes into the university sector as a result of bids from individual university scientists and engineers, and then there is no question about it, the people then move over to become the responsibility of the university, although the money comes from the

[Baroness Hilton of Eggardon *contd.*]

research councils, just as, for example, if a charity decided to put some money into a particular group in a particular university, the university would manage it, and just as if industry put money in, the university would manage it. So it becomes the employer. There I think it would be a little bit tough to suggest that the research councils also have a direct responsibility for managing those people. Yet they do have a responsibility in human terms and this is what we are addressing in our group. We are trying to come forward with a good solution which recognises that the legal responsibility for proper practice and management is with the universities and I would not want anyone to think that there is a terrible scene out there. There is very good practice throughout the universities. It is patchy, of course, as we all know, and yet the research councils do not have the responsibility but they provide the money. But yes, this is the issue.

102. Of course they do not have direct responsibility for the management but the fact that they provide the money is a very powerful lever. You draw the analogy with the charities but I would have thought that any charity giving money to a university would want to ensure that that university or that research group operated in accordance with some particular ethical concern that charity might have. I would have thought the research council had a similar obligation to ensure that the university was managing its staff in an appropriate manner before it gave any grants. So I am not suggesting direct management, of course I am not, but I am saying they have a very powerful lever in their hands when giving grants.

(*Sir John Cadogan*) I agree, and this is precisely the concern of the concordat that we are trying to work to, so there can be no misunderstandings about it.

(*Mr Barker*) That is absolutely correct. There are two things I would like to develop slightly: picking up the point Sir John has already made that it is not all bad out there, I think the point to some extent is that there is very good practice in individual universities and individual departments, but some of them are not of that same high standard, and so one of the things which we are aiming towards is to encourage best practice on the part of the universities as employers, in other words bringing them all up to the standard of the best. Secondly, I do indeed take your point that the Research Councils have some responsibility to ensure that the money that they place into universities, for example, goes to fund people who are employed under good practice terms, and the sort of areas, for example, which we are developing with the Research Councils and the Royal Society for research projects in the universities concern issues such as performance appraisal, career guidance and management, ensuring that contract research staff have adequate counselling because, as we have already said, not all contract research staff should or, indeed, wish to remain in universities. So these are areas where some institutions already have very good practice and we would like to bring them all up to the best in those areas.

Chairman

103. We did visit University College London and Imperial College to see their schemes and we may hear what is going on in Scotland later. Arising out of this also, is there a general perception as the word goes around suggesting that it is an under-privileged group? Have you any evidence as to whether—it is often said but we have no evidence yet—this has a deterrent effect on good people taking up these posts?

(*Mr Barker*) My Lord Chairman, there is some anecdotal evidence that suggests this group of people feel they are under-privileged and discriminated against, but hard evidence is much harder to come by. One thing I would point to is that there does not appear to be a shortage of excellent candidates for these posts.

104. I suggest that is part of the employment market.

(*Sir John Cadogan*) The Royal Society Fellowship Scheme is attracting quite outstanding young people and indeed bringing some of them back from overseas.

105. Even if you have not got evidence on it, it is quite clear that if you do bring the conditions of work of these people up to an acceptable standard that can no longer be seen to be a deterrent.

(*Sir John Cadogan*) Absolutely. It can only be a good thing and a proper thing.

Baroness Hilton of Eggardon

106. I wanted to go back to your mention of Warwick University and the decision to appoint 50 long-term research staff. I wondered whether that was going to be a growing trend and, if so, do you approve of it and do you think that that is the right way forward?

(*Sir John Cadogan*) I think the Warwick scheme is an excellent scheme. They are six-year fellowships. Interestingly enough, perhaps ten years ago we would not have thought of six years as long-term. It is a sign of the times. The University has been able to find enough money to do this because of its success in connecting with industry. My personal view, and I believe it is the view of the Office, is that the more of these there are the better. I expect other universities would wish to follow suit if only to be in the competition because the Vice Chancellor of Warwick has stated publicly that he has had an extraordinarily good response of very very high-calibre people for this and other universities will want to be in the same field attracting these people, because I believe the university thinks that most of these 50 will in fact move into permanent posts in due course. Other universities will desperately want to do it. Their ability to do it will depend on their financial circumstances.

Chairman

107. It would be a wise provision if you are going to have vacancies among your staff in a few years time having these people already there, which would be a great asset.

[Chairman *contd.*]

(*Sir John Cadogan*) Absolutely, which is why I think it is an excellent strategy. Indeed it is one of the reasons why the Government decided last year to increase the Royal Society fellowships because they saw this coming. There is a slight indication that already more people are moving out of the Royal Society Fellowship Scheme into permanent jobs. It is no more than an indication, but it is a healthy indication.

108. It is a bit like confidence in the economy!

(*Sir John Cadogan*) Indeed, I think so.

Lord Phillips of Ellesmere

109. What percentage of university income from all sources is "soft" money?

(*Sir John Cadogan*) I am bound to say, Lord Phillips, that I am in a little bit of difficulty because I would have called that "hard" money. "Soft" I understand is in your terminology money which comes in from contracts from Research Councils.

110. Not only contracts from Research Councils but charities, industry, government departments, wherever, not as block grants.

(*Sir John Cadogan*) Personally, I regard that as harder money because people most of the time have to make a scientific case which is judged by peers, whereas if I am a practitioner in university and I get money from the university block grant I do not actually have to make a case to anybody. It is on my general reputation and status. If I go to a Research Council I have to make a case so I would regard it as hard money. That is not the point. We do not want to argue about hard and soft. The proportion has increased over the years. In the period 1979-80 to 1992-93, as David mentioned earlier, it has gone up from 13 per cent to 21 per cent. Of course comparing 1979 with 1992-93, which is the last year we had figures, is a little bit difficult because there has been the question then of changing the system of fee structures and so forth. Nevertheless, I feel without being able to justify it on scientific grounds that to think our colleagues in the universities were getting 20 per cent of their money judged against peer review outside is rather a good thing.

Chairman

111. On that particular point, does that figure of increase take into account the transfer of funds from the funding council to the Research Councils and, if so, therefore, should it be deducted from this supposed increase that you have just mentioned or is it a genuine increase?

(*Mr Wilkinson*) It is genuine. I think we have taken account of that[5].

112. The point about the universities is of course that they are rather nervous about their own finances and during this period of uncertainty they would like to see themselves increasing their soft money income, but many of the charities to which you have referred (and I am President of a large one in this respect) are getting worried because they see themselves dragged along with providing the support money which the Research Councils are now giving to the universities to support their grants which the charities, as I am sure you know, are reluctant to give.

(*Mr Wilkinson*) Indeed.

113. Added to which, of course, they are all very nervous at the moment about the effect of the Lottery on their income. I think this reflects back to university decision-makers who feel it is rather difficult to commit themselves for five to ten years ahead.

Lord Phillips of Ellesmere

114. Could I explore with Sir John this issue in rather broader terms? It seems to me the universities over the last decade or so have seen not only an increase in what we call here "soft" money, that is money allocated over short periods by various agencies as opposed to the old quinquennial grant which they relied on, they have also seen the old UGC grant divided up into partly student fees and partly other grants. As they see it, instead of having as in the old days one rather large fairly constant source of income, they now have multiple streams of income which have to be managed, to go back to Lord Dixon-Smith's point. That is something which I think they have experienced already and which has made many of them nervous, as my Lord Chairman says. It seems to me we have to look at that against a background in which industry increasingly is seeking to do as much work as it can by contracting it out rather than maintaining its own major establishments and so on. This for universities represents in one sense a marvellous opportunity. They could become the research agency for UK Limited. On the other hand, it will depend upon them being able to manage even more funding schemes with even less certainty. Do you see that with your industrial background as part of the picture?

(*Sir John Cadogan*) Exactly. That splendidly depicts the increasing complexity which faces them. Coming from industry, I do not believe that that is actually a serious problem because I had a huge budget when I was in industry and hardly any of it was guaranteed for more than a year and its shape and its colour changed from year to year; one business would want more, one would want less. It was a real issue of scientific management and judgment as to where you should put the cash. I do not think the universities will be faced with the same complexity of managing its source as industry has. You are quite right, it is complex and it is a great opportunity for universities. As the universities will no doubt have told you themselves, they really are trying to get out there and get a larger part of the action in a splendid way. We have talked about the University of Warwick already. They have done it and look at the outcome.

115. The increasing importance of detailed industrial-style management within the universities?

(*Sir John Cadogan*) Yes.

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[5] The USR data is not likely to have taken account of the transfer; doing so reduces income from research grants/contracts from £1086m to £1011m, or from 21 per cent to 19.5 per cent of total recurrent income, in 1992-93.

Chairman

116. There is a difficulty here, is there not, that if the balance swings too far towards the applied contract end then there is a danger of losing the science base within the universities in various areas, which has to be watched. I imagine that is something which is your business to keep an eye on?

(*Sir John Cadogan*) It is precisely my business and I would regard it as my first priority to make sure that the universities do not become short term and that we do preserve the strength of the science base. The Government has made a very clear statement on that in the *Forward Look*. Industry does not want universities to become short-term problem solvers for industry and it does not intend that to happen. It is my duty in this job to make sure that the balance is right. I cannot stop industry putting applied money into the universities, but what I want to do and my advice to Government is to ensure that we do not do anything which pushes the thing the other way -quite the contrary.

117. Just to put the thing in a nutshell, are you reasonably confident from your experience now in the Office that the universities are adapting and that this is a difficult transition stage in which to make judgments therefore?

(*Sir John Cadogan*) It is difficult to make judgments. I do not know when, my Lord Chairman, we will get to a steady state where we will be able to confidently make judgments, if we ever get to a steady state. I have not got a full statistical analysis of course, but I have spent a great deal of my time going round individual universities and research groups, etc. and the thing that certainly has struck me and has encouraged me is how strongly universities, particularly on the engineering and science side, are trying to get connected to industry. They really are trying to do it without trying to turn themselves into workshops. It is very very encouraging. It has been encouraging to see that certain sums of money which have come to them either from the funding councils or from charities or from the Research Councils have been used to lever up funding from outside agencies such as the Commission and indeed industry. Generally, industry actually does not want short-term widget making. It actually wants more strategic work to be done. Lord Phillips said that industry is increasingly out-sourcing, but what they are really out-sourcing is their strategic research.

Lord Haskel

118. Can we explore the flow of scientists between industry and academia? You say in your paragraph 28 that the flow into academia exceeds the flow out, but it is very small. Is there any evidence for this and is there any ideal target as to what the flow of scientists between industry and academia should be?

(*Sir John Cadogan*) There is not a target. Whether there should be one is a matter for debate and if there should be one, what it should be is an even more difficult one. The facts are that the numbers we have relate to wholly university funded staff and the in-flow from industry, according to our numbers, is 150. I am sorry, I cannot remember over what period[6] but the ratios are important: in-flow, 150, out-flow, 45, so it is in rather than out. One can speculate on why that is. I am very happy to speculate based on my own experience because you are looking at somebody who was part of the small out-flow from the universities into industry. I left university after 26 years and went into industry and I took 18 months to make up my mind because actually it was extremely attractive at the university. I was taking on a big risk going into industry. When I had my industrial job I deliberately pursued a strategy of bringing in excellent scientists and engineers from the universities and we were very successful in this. We brought some 13 or 14 people in at professorial level on a short-term contract, paid them a BP salary, made them work like BP people, assessed them, gave them a hard time, but they got all the benefits and they did have the opportunity to go back. I am glad to say that a significant number of them decided to stay inside industry but I can vouch for the fact that it was extremely difficult to get these people out of university. The fact is that it is an attractive career still and if you are a top-class person there are not really any financial disincentives either because, of course, they can do quite well through consultancies etc. We must never under-estimate the allure and seduction of being able to pursue things that you think are important to pursue. That freedom, of course, is not there in industry and I am not surprised that the in-flow is that way.

119. Of course, there is a grey area in the science parks which are attached to many universities, where people from industry and academia are working part-time. How do you classify those people and is this an area where the flow of people could be regulated?

(*Sir John Cadogan*) I do not have enough information across the piece to answer your question, but I believe that in the main academics working in science parks still have their academic lifeline, they still are so-called permanent staff of the university, so they have that security and, therefore, it is quite attractive for them to do it and I think that is a good halfway house.

120. Are there any people working the other way round? Are there people from industry who are working in science parks who have their roots in industry but are half in academia?

(*Sir John Cadogan*) Yes, I can think of instances but again I do not have a full statistical picture. Very often, of course, the industrial organisation sets up those science parks because it is attractive so to do, and their people work for the industry and also very closely with the university, but they are still industrialists paid for, pensions, terms and conditions etc, by industry.

Chairman

121. Do you see scope for dual appointments? I mention this because when the University of Berlin was set up by von Humboldt in the early nineteenth century, he specified that there should be dual

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[6] 1993 (table 32 of University Statistics 1993-94, volume one, Students and Staff (USR).

[Chairman *contd.*]

appointments and from that sprang the great links of German industry with German universities. I did it myself in Nottingham some 35 years ago. The difficulty was that the demands of industry for people spending one or two days a week within the university was the problem of urgent business. It worked very well with Unilever, agriculture research at Culworth House in Bedfordshire and our Agriculture Department, but that was a more leisurely thing. Plants take time to grow, animals to show and so on, but with Rolls-Royce, with the best will in the world, at the time of the RB 211 there were pressing issues which naturally tended to withdraw dual appointees from that university, which made it again a problem of management.

(*Sir John Cadogan*) That is right. It is possible. I believe there is scope for dual appointments. Indeed, the scheme that I described from my last job essentially were dual appointments. Many of the people came to us for two or three years. Although they were BP employees they had research teams to run back at the university and we had an arrangement with them that perhaps they would have a day a week when they could be back in their place or sometimes three days a fortnight, depending, but it was made very clear to them that when the chips were down their allegiance was to the company. They were there, they were given a real job to do and they had to deliver, and what was interesting, of course, was the gusto with which they did it. It is actually extremely exciting to work in a high-tech research laboratory close to practicality. Some of our academic scientists would be working on the fundamentals of electrochemistry related to corrosion, say, and they would find themselves at two days' notice on the Alaska pipeline, which was tremendously exhilarating. So we did not have any difficulty in managing it.

122. From your point of view, of course, there is another player in this field of industry/university, or was, shall we say, and that is the DTI. A good deal of concern has been expressed, and Lord Craig, perhaps you would want to ask about this, but the first thing I would like to say is that we have some concern about the state of affairs with the LINK scheme. Do you, from your point of view, keep an eye on these things?

(*Sir John Cadogan*) Yes. I have considerable contact with the LINK scheme, although I cannot answer for DTI, obviously. The LINK scheme is a good scheme, I believe. It is being relaunched very shortly by the Chancellor of the Duchy of Lancaster. It is going to be revamped, which the Chancellor will be dealing with shortly. There has been an extensive review of the LINK scheme with all the users, all the participants, all the research councils. Of course, the research councils are key players in the LINK scheme and, indeed, considerable sums of money go in there. The principle surely is an excellent one, that you would use this in a pre-competitive way, match government money with industry money, as partners. There are certain segments of industry which use this greatly and love it. There are considerable sums of money in there. Money comes from DTI, it comes from MAFF, from research councils, from wherever.

123. I think there was some concern that DTI money might be shrinking. Is that the case?

(*Sir John Cadogan*) I have no evidence of that. I cannot speak for what the DTI budget is likely to be in the future, I am afraid.

(*Mr Wilkinson*) The DTI has said that its investment in the LINK scheme will be maintained at its current level.

Lord Craig of Radley

124. When can we expect to hear when the LINK scheme relaunch comes about?

(*Sir John Cadogan*) It is pretty soon. I do not know that we have a date yet.

(*Mr Wilkinson*) No, there is no date set but the Chancellor will be announcing it shortly.

(*Sir John Cadogan*) The review has very recently been completed.

Lord Phillips of Ellesmere

125. This is being relaunched because it has gone into decay or because there are new ideas about how it should operate?

(*Mr Wilkinson*) Because there are new ideas about how to make it more effective. If I could, my Lord Chairman, tie that back to the original question from Lord Haskel about targets, whilst there are no targets for flows of people between the industrial and academic side, the whole government policy in *Realising our Potential* is to increase interaction between the two sides in ways that you have described on science parks and also in ways that Sir John has described, and of course LINK again is one of these areas in which what the Government is very much hoping to do is to improve the exchange of ideas and willingness to discuss matters of mutual concern between the two sides. So there is definitely a target for increased interaction and increased mutual understanding, even if this does not translate into specific targets for people to cross the barrier in employment terms.

(*Sir John Cadogan*) If I could follow that up, in answer to Lord Phillips' specific point, I do not think there has been any question of LINK being in decline, but I think it is a good thing, is it not, to have a root and branch review of any scheme that has been running, in my view, for five years. LINK could have been running for rather longer[7]. So the opportunity was taken by the Chief Scientific Adviser and his Adviser to have a good look at that.

Chairman] I think a lot of people are nervous that you are looking at schemes following the experience of the Efficiency Scrutiny. That is a comment which does not require a reply from you. Perhaps we ought to move on. Lord Phillips, I think you wanted to put a question?

Lord Phillips of Ellesmere

126. Mrs Sharp, it is very nice to see you and I hope you are enjoying your very important role. Would you like to begin by expanding on any of the

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[7] The first LINK programme began in 1988.

[Lord Phillips of Ellesmere *contd.*]

paragraphs in the paper on what you are doing and what your initial experience has been?

(*Mrs Sharp*) Thank you for your warm wishes. As I mentioned earlier, I am very encouraged by the moves that are already taking place. Many of the providers of funding for research are already beginning to move towards the implementation of measures which will make it easier for women to follow careers in academia. Many of them are looking at efforts such as flexible working, retraining schemes, part-time working, career breaks—many measures which will make it easier for women to combine the responsibilities of a family with a career. I think this is the area of the report on which I would like to focus.

127. I know it is always a great temptation for someone coming into a job like yours to think, we do not know enough of this, let us have a study. Nevertheless, I cannot avoid the thought that there have been in the past, and indeed there are at present, a great many successful women scientists. Has anyone ever looked at what it is, if anything, that these people have in common that has made them successful in an inclement situation? I will cap that by saying I could say that when I came into my particular branch of science two of the most important role models, I might say, were very successful women. Have you looked, has anybody looked, at what it is that makes these people successful?

(*Mrs Sharp*) I am not aware of any studies that have looked at it from that particular aspect. There have certainly been a number of studies that have looked at the problems, that have tried to identify the problems which women have in careers and those have pointed to a wide range of problems which cover a wide spectrum, but I am not aware of anything that has focused on success.

128. Do you not think that might be a good idea?

(*Mrs Sharp*) The Unit has been looking at the research which has already been carried out and has been looking also at the statistics on the numbers of women who are in academic careers and has identified that there are a number of issues which are still ambiguous and which need to be looked at further. In taking this forward I will bear this in mind and will look for measures of success as well as indications of problems.

129. It is, of course, Lord Chairman, a very complex social problem in which I would expect you to be talking to other government departments. For example, the provision of creches or nursery schools would impact to some extent on how much women can remain in work at least for a significant time during the period of raising children?

(*Mrs Sharp*) I am indeed liaising with colleagues in many departments on many issues. On the matter of child care, the evidence from the Commission on University Career Opportunities, which was commissioned by the CVCP, showed that something like 75 per cent of universities are already setting up nurseries and creches, so there is already good momentum there. We obviously have to try and encourage the other 25 per cent to go along with this as well, but child care is an issue which the universities seem to have already taken on board.

130. I am intrigued, finally, by the beginning of paragraph 39, which says: "Contract research work in universities may deter some women from pursuing a research career of any kind .... " It was rather difficult to elicit a response that this deterred men. Why should it deter women?

(*Mrs Sharp*) The deterrent which may exist is in the terms and conditions of employment. For instance, you mentioned child care; we are aware that some universities which do implement nurseries do not necessarily make those opportunities available to the contract staff, but this is something which the employers are now aware of and there are encouragements being made to persuade them to make these available to both fixed-term and open-ended contract staff.

Lord Renwick

131. On the same subject, my Lord Chairman, I would like to ask Mrs Sharp if she is aware of similar problems being found not in careers in science or in academic careers but even in ordinary jobs especially to do with science and technology and to do with information technology? I recently visited WIT's[8] information and technology unit and was very impressed at the work they are doing. I am impressed that the girls in schools are aware that information technology is a very good career for women, although evidence shows that they need to be explained this and the numbers are falling away even there. You obviously know those efforts in those areas?

(*Mrs Sharp*) I do indeed, yes. The Unit will be very active in working with expert bodies to increase the awareness that girls have of the challenges and opportunities that are available in science, engineering and technology. This is one measure that we will be active in. You mentioned other types of employment as well. You may be aware that the Chancellor announced last week that we are going to be producing a brochure jointly with Opportunity 2000 which will lay out in a number of case studies the economic and other benefits of implementing family-friendly policies and this will apply to employers in universities as much as it does to any other form of employment.

Lord Howie of Troon

132. I was invited yesterday to attend the annual conference in September of a body called the Women's Engineering Society which has gone on for quite some time. They explained to me that they were rather hard up and I would have to pay my own fare. Since the conference was in Glasgow this caused me a certain amount of alarm, but I will go just the same. I wonder if Mrs Sharp's remit at the Development Unit, which is something which the Women's Engineering Society is very interested in, goes as far as providing funds to voluntary organisations of this

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[8] Women in Science and Technology.

[Lord Howie of Troon *contd.*]

sort whose business it is to encourage women into science and engineering?

(*Mrs Sharp*) My remit does not include that. The Unit is a facilitative body which will carry out its remit through stimulating and encouraging the activities of expert bodies and other groups. There have been instances where I have been able to find funding for good initiatives through liaison and coordination with other bodies. It is a case of my Unit acting as a focal point to identify where opportunities and resource funding are and to try and then focus that to provide the biggest benefit that we can.

133. So you have the facility to bring together people who need money and people who have got it, is that what you are saying?

(*Mrs Sharp*) That is one of the things that I have been trying to do.

Lord Haskel

134. In industry one of the ways in which the employers have combatted their attitudes towards women is to try to bring to people's attention the special qualities that women bring when they come to the job: for instance, it is often said that they are less confrontational and provide a different ethos. Are there any special qualities that women bring to science which maybe we ought to be aware of which will have an effect on what we are discussing?

(*Mrs Sharp*) I think that whatever walk of life a woman goes into she brings certain qualities; science is no exception. The Government laid out in its White Paper "Realising our Potential" that it wanted to attract the best people into science and engineering, and no doubt many of the best people are women.

Chairman

135. It has always seemed to me that if I were going to study the problem of women entering science I would want to look at the proportion of girls who do GCSEs or in deference to your accent, Scottish Highers, and then I would want to see how they go on into higher education and how those proportions are maintained at the undergraduate level, then the entry to the research student level and then subsequently. The reason I ask this is because in section 39, to which Lord Phillips has already referred, one can read that it would seem, as it were, that women are in some cases filling these lower-paid, less-advantaged jobs. We have already described these contract staff as not being on all fours with the academic staff. Are they seen as cheap labour and is that why they find themselves there or have you not examined the intervening steps?

(*Mrs Sharp*) I have got no evidence to say that that is the reason. I have certainly identified from the USR data that there is a decline in the number of women as you go up the seniority ladder.

136. There is a loss at each stage?

(*Mrs Sharp*) Yes, and there appear to be many factors that contribute to this. What I am trying to do is actually to identify clearly what the main factors are, but at the moment it is still very ambiguous.

137. Is this on-going because I have noticed myself quite remarkably, just seeing graduates come before me, a rising tide of women both in engineering and in chemistry which used to be a male preserve. I have not seen it yet to any great degree in physics, but biology of course has always been strong. Are you looking at these figures, because they are available from the USR?

(*Mrs Sharp*) I am indeed looking at them, yes, my Lord Chairman.

138. Will you make your information public?

(*Mrs Sharp*) My Lord Chairman, it is not just a case of looking at the data. The data identified that there is a problem. Actually identifying what will solve that problem is the difficulty. Whilst there have been pieces of research which have looked at this in small samples, they come up with a wide range of factors that might be the cause and so what I need to do is to actually try and identify which of those many factors are the ones that are the main obstacles.

139. It will be very difficult to get hard evidence in a short time, will it not?

(*Mrs Sharp*) Indeed.

140. Perhaps we ought to go on to our last topic, the Master of Research qualification, which you seem to be quite "gung-ho" about in your evidence because it is a good thing and yet, Sir John, you are a chemist and you will be well aware that the chemical industry and the pharmaceutical industry is less than enthusiastic: in fact one could say in modern terminology they are sceptical about its value in that subject. Are there other areas with negative responses from industry?

(*Sir John Cadogan*) The responses generally were pretty good. You will recall that the Research Master's degree was defined by the Government as a free-standing one year operation, and will be piloted as such. It is not meant to be a feeder to the PhD. Indeed, the chemical and pharmaceutical industries particularly did not like the idea of the PhD running for four years with this precursor. I think the Government has really met those objections. It is another option.

141. Without the financial cost of the number of PhDs?

(*Sir John Cadogan*) No, certainly not.

142. We were told the total sum of money was fixed?

(*Sir John Cadogan*) It is entirely up to the Research Councils as to how much money they put into these things. They have the decision. There has been no edict from anywhere that says the total sum of money for postgraduate training has got to be this or that sum of money. It is a variable feast. It is looked at every year by the Research Councils. There has been an assumption that one would be at the expense of the other. Clearly, if a Research Council as a result of this pilot decided that it was so enormously successful that it wished to have thousands of these, it would have to take that into account in deciding where its money went. It is a pilot. It is being run by a limited number of councils. Quite a large number of applications have come in. They are being assessed now. It is about 50 at BBSRC. EPSRC has had 140

[Chairman *contd.*]

applications[9]. Councils are at this stage proceeding to allocating university courses. We will see the first students come in in October. It will run for one year so this takes us into October 1996, so I suppose we will get the first indication of how it has gone in the spring of 1997. We intend the pilot to run for three or four years.

143. Were not the criteria for the allocation of these M.Res resources....
(*Sir John Cadogan*) For the allocation of the resources?

144. Approval of resources?
(*Sir John Cadogan*) Each Council is drawing up its own guidelines according to its particular community, but the standards will be as high as anything required for entry into postgraduate schemes in science.

145. Will the selection of the institution be on approved research records in that particular subject or will it be on the ability to teach?
(*Sir John Cadogan*) That will be an important part, but each institution has been asked to make its case and remember that the M.Res is primarily a research degree, but a significant proportion of time will be spent on broadening the student's skills in communication, public understanding of science, management—not that we are trying to turn them into the Chairman of ICI—IT, all of those things. So each university is having to make its case and those criteria are then measured by the individual Research Councils. We are quite early on, you understand, my Lord Chairman.

Lord Craig of Radley

146. I note, Sir John, that it will not be a feeder to the PhD as you have just suggested—
(*Sir John Cadogan*) It could be.

147. In general you do not expect it to be?
(*Sir John Cadogan*) It is designed as a one-year free standing degree. There will be no reason why those students should not then decide that they wished to go on to do the PhD. My experience of a very large cohort of science students when I was in Scotland is that generally a lot of people rather thought they would quite like to do research for a year but they did not really know whether they wanted to do it for three years, so we are actually targeting a different market. I would expect, and this is a personal view, that a certain proportion of those might be so fired up by what they have done that they would wish to register for a PhD and they will then be treated as anybody else. It is not designed as a feeder for the PhD, it is designed to give them a qualification which will be of significant value to them as well as to industry.

148. How would you react to the view we have had in evidence to us which suggests that the M.Res would be no more than a means of signalling scientific literacy in people pursuing careers other than in scientific research and seen of being of little relevance in fact to a career scientist?
(*Sir John Cadogan*) If the person is going on to be a career scientist there are two ways: directly through the PhD or via Research Master through the PhD, in which case the criticism becomes invalid. It is an additional qualification post-bachelor. Certainly in my last post I could have found places for a lot of these people coming in who had something rather better than the bachelor and they would fit in and would go forward. Indeed many people in my organisation got right through to the top and had never taken a PhD. It was not a pre-requisite. So I hear their views and, indeed, it may be that in their particular expertise that is correct, but in the broader sense of an industrial context rather than a service context I think there is little to fear.

149. Do you accept the view which has also been expressed to us that there needs to be a great deal of flexibility in the approach to a Master of Research qualification, in other words, that it cannot be to a particular format?
(*Sir John Cadogan*) I agree entirely and I think you need to have no fears about that. The one thing I have learned in my job is that there is no uniformity whatsoever between the research councils.

150. That would take us into another field of debate, I think.
(*Sir John Cadogan*) Indeed, that is one of the strengths of the system.

Lord Howie of Troon

151. Before we leave this subject, would there be any possibility of this degree forming the first year of a three-year PhD?
(*Sir John Cadogan*) That will depend entirely on the university. There is no reason why the MRes should not be a good start for a PhD. Whether that PhD becomes a two-year PhD or a three-year PhD is entirely up to the university, whether it allows a two-year PhD or whether, indeed, the person makes enough progress but, of course, you cannot subsume the results of the research for the MRes for the further degree. The university regulations do not allow that, so you cannot "piggy-back", but I would guess, if I may say so, if you had a very good student who had done the MRes and then went to the PhD, I would not be surprised—Lord Dainton has much more experience of it than I have—if that person would be a pretty good runner for finishing in two years.

152. In paragraphs 23 and 24, to go back a bit, you talk of the age profile and the age profile problem. I know what you are at but I am wondering if there is a sort of ideal or preferred age profile or whether it is just a matter of moving out older researchers to make room for younger ones?
(*Mr Wilkinson*) If I may, one thing which seems to be common ground between the universities and the research and scientific community generally is that it would be as well not to replace one bulge with another. Therefore, as the sixties' bulge moves out, there is available, as we have been discussing this morning, a group of people with experience of working on fixed-term contracts. There are also people completing their PhDs—just those supported

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[9] Igo expressions of interest.

[Lord Howie of Troon *contd.*]

by the research councils, come to about 3,000 in science and engineering a year. I think that in terms of responding both to the different funding streams that Lord Phillips mentioned and to market opportunities that Lord Dixon-Smith mentioned, what one would now expect would be for the universities to decide on the best balance that they can get between good new young people and drawing on this fixed contract grouping that is available. The idea being that the universities should be able to respond to the market opportunities that have emerged as we have developed this research market. May I say, Lord Chairman, that it does seem to me that in many ways it is the response to the competition and the universities pursuing their share of the action that is going to lead to initiatives whereby the universities themselves manage this group of researchers better, because with a better motivated and better managed group of researchers you are more likely to win your share of the business. So I think there is pressure on the providers but I do agree with Lord Phillips that that should be doubled up by the pressure that the customers provide, in particular the research councils. With the dual support transfer, as you know, Lord Dainton, the research councils have forward-committed a large part of their funds to the universities and, therefore, they are, as Lord Phillips says, in a very good position to be setting conditions for the dispersal of those funds between universities.

153. So a good deal of this career management that we were talking about consists of managing early retirement?

(*Mr Wilkinson*) That is certainly one aspect of it, yes.

Chairman

154. But in the case of Scotland, of course, the HEFC there has felt it is necessary to intervene and really introduce a scheme which is like the old premature voluntary retirement plus new blood. Is the Scottish system more osteo-arthritic than the English one?

(*Mr Wilkinson*) I think the fact is that both funding councils—I do not know what the Welsh are doing, by the way, but certainly the English funding council is currently conducting a study and, as you well know, it has behind it a couple of new blood schemes, but obviously it depends very much upon the balance found. But yes, there is obviously a decision in Scotland that action now is needed.

Lord Craig of Radley

155. I think what Mr Wilkinson has just said there is of extreme interest and importance. Could I deduce from it that you do not believe there is any prescriptive right for those who enter the research scientific world to be given a career from the cradle to the grave?

(*Mr Wilkinson*) I think what has emerged—and I am sure the Committee is finding—is that we have here a long-run secular trend within the universities away from a position in which there was uniform funding by grant-in-aid from the government to a multiple flow of funds. The universities have to respond to that and they need flexibility to do so and this has affected their employment practice. In parallel with that, outside the universities there is increasingly a move away from careers for life. To take the example of Sir John's group in OST—40 people working on a policy area in the Civil Service—of the 40, seven, including Sir John himself and Mr Barker, are on fixed-term appointments. I think the universities are part of a linked twentieth century trend in which, as you have said, we are moving away from a career for life to working for an organisation which has to earn income. But I do believe that it is then incumbent upon the organisation to have a plan—I hesitate to call it a business plan for universities to you, Lord Chairman—in which it anticipates its earnings and makes appointments accordingly. As Sir John drew out in one of his interventions, the fact that Warwick University has done that is a response to the market. But it is also an indication to the market that if they place contracts with this university they are going somewhere where the university is determined to have good people properly looked after, and I think that that market pressure will actually improve the quality of management.

Chairman

156. Thank you for that very fluent statement. I hope you are not going to apply those principles to this House, otherwise there might be some point in that.

(*Mr Wilkinson*) That is beyond my remit, Lord Chairman.

157. This brings us naturally to a conclusion but not before I ask if there are any points which we failed to elicit which you would like to put before us, points you think we have not covered adequately? There is, of course, always the chance of putting in something further, if you wish to do so, in writing.

(*Sir John Cadogan*) No, I do not think so, my Lord Chairman. Thank you again for receiving us so courteously. I should say that we await the results of your deliberation with great interest, and quite frankly, I hope that your deliberations are going to make our job easier.

Chairman] I do not think we set out with that intention necessarily but it may happen on the way. Thank you very much.

TUESDAY 7 FEBRUARY 1995

Present:

Craig of Radley, L.	Hilton of Eggardon, B.
Dainton, L. (Chairman)	Howie of Troon, L.
	Phillips of Ellesmere, L.
Dixon-Smith, L.	Redesdale, L.
Haskel, L.	Renwick, L.

Memorandum by the Association of University Teachers

1. We are grateful for the opportunity to meet the Committee. The Association represents research staff in the "old" universities whether on long or short-term contracts and at all levels in the profession. Given that over 92 per cent of funded university research occurs in these institutions, we can fairly claim to represent an overwhelming proportion of such staff. The Association negotiates at national level for their pay and to a more limited extent on their conditions—conditions negotiations are generally conducted in individual universities and research institutes. We are responsible for the pension scheme (USS) and for representation on professional matters.

2. We have been concerned for many years that the interests of the UK have not been well-served by employment arrangements of researchers. From the point of view of the national economy, which we argue has prospects only as a leading-edge economy, it is important to consider in detail the position of graduate scientists. This emphasis does not diminish our view of the importance of careers in humanities, social sciences or other areas. Our concerns have focused on specific issues:

2.1 Despite interventions like the Science White Paper, there have been no appreciable changes for the better in the career prospects of science graduates. Indeed, we believe things are getting worse. With a few notable exceptions, the pattern of funding has been argued by universities to reduce their scope for structuring careers. The result has been that science graduates are increasingly subject to short-term contractual employment, and to successions of short-term contracts. They are generally asked to sign waiver clauses so that a succession of contracts does not lead to accrued employment rights. Equally, it remains uncommon for any bridging funding to be available to employ such researchers between contracts. The consequence is that employment is insecure and many of the attributes of a sound career are not present. Two examples help illustrate the point.

(a) We have asked a number of mortgage lending companies to access the position of typical contract researchers in their late 20s and early 30s. The combination of insecure employment and pay levels led all those with which we discussed the matter to conclude that they would be unlikely to advance a mortgage. We believe this may also be the case with other credit. Alongside an absence of career planning potential, there is little that can be done about planning other features of life.

(b) Research staff experiencing breaks in their careers, and this is far more common among women than men, are generally, when re-engaged, put back to the starting point on pay scales or, in any event, to a lower scale point than the one they occupied before the break. While this is often argued to reflect the exigencies of funding, in reality it means that career progression is radically reversed.

2.2 The pay of graduate scientists in academic life whether in specific research or teaching/research posts is now considerably behind salaries of comparable groups in the economy as a whole. The problem can be worst for research graduates because it is increasingly common that universities employ them below nationally agreed minimum points for age and qualification. The short-fall in pay in general has been noted by the Vice Chancellors, ourselves and all independent commentators. The Association believes it will only be remedied through a pay review body. Two other issues are important in this regard. First, with the removal of the security of tenure (enjoyed hitherto by most academic staff) and with far greater direct regulation of work content and work pattern by virtue of funding systems, those factors previously regarded as in some sense compensatory have been removed. Second, a combination of low pay and insecurity has increasingly meant that science teams cannot be kept together. Few conferences—including those dealing with the interface between university science and economic well-being for the UK—do not comment on the fragility of UK research teams.

2.3 Many graduate scientists are looking for careers exclusively in research. However, many also wish to teach. Success in achieving a teaching appointment comes relatively late in the initial career of graduate scientists. It is a long "apprenticeship". The age profile of university teachers shows that over one third will retire in the next decade. Financial restrictions have meant that relatively few new posts have become available with the consequence that the average age of the cohort has increased throughout the last decade. The Association has referred to this problem as a "demographic time-bomb". It is ticking away and nothing has been done to defuse it. Yet the consequences are plain—the UK will not have enough experienced scientists in its universities.

Additionally, the relative stagnation described has meant that there is relatively little career progress among those in academic posts. Alongside the lack of "new blood" planning there is little succession planning. There is little doubt that the weight of these problems is understood by Ministers but the view prevails that the system will somehow adjust itself or that it can be prompted to do so through funding council measures—suitable penalties once a university has got it wrong. We submit that it is more sensible to correct a problem while there is time to do so, and that this is especially so where its characteristics are well-known.

3. On the professional front, the Association has observed that most contract research staff are excluded from collegial mechanisms within their universities. They are sometimes not defined as being "members" of the university and thereby excluded from elections for staff representatives, from academic and course boards, and from the culture of the university. Aside from the clear message about poor valuation, it does not bring research staff into the processes in which they will need to work if their academic careers progress. This is particularly acute for scientists because the nature of the work frequently isolates them in their experimental environment. We observe that, compared with the arrangements formerly operated by the CNAA, for example, that graduate scientists are systematically marginalised from the academic community to the detriment of their institutions and of themselves. Quite aside from the contribution which they would make—there is a clear indication of this in the "flat" structures observed in the businesses highly dependant on research and development (leading edge industries and services)—there is little encouragement to become part of the academic community and we believe that the sense of membership is highly valued among academics. Thus, there is a further discouragement to establishing a career pattern.

4. Many of the employment and professional issues are inevitably linked. The Association, after years of research demonstrating the contentions made, achieved an agreement with the CVCP on good practice in the employment of research staff. It was then found that the bodies providing funding who are not employers were not prepared to operate in terms of the agreement. While they have held further discussions with the CVCP, and while there has been a strong indication from the Office of Science and Technology that progress would be helpful, no good employment scheme is in place. It is symptomatic of the problems described that it has proved impossible to get the interested parties in the same room at the same time. The Association has the twin objectives of seeing the maximum development of the potential of UK university science and the well-being of our members. It is a matter of great regret that an expedient as simple as holding joint discussions has not been possible. We believe this is due in part to short-termism in funding and planning. But it is also due to what is sometimes described to us as the convenience of having a workforce that can be dismissed without undue difficulty at short notice. Paradoxically, as the pattern of repeated short-term contracts demonstrates, it is more the sense of a power to dismiss, a sense of control which accompanies the insecurity of others, that appears to be at stake. It can hardly be a rational basis for employment, least of all of a group so critical to our national prospects.

Examination of Witnesses

Mr David Triesman, General Secretary, Mrs Adrienne Aziz, Assistant General Secretary, Miss Natalie Fenton, Research Officer, University of Loughborough, and Chair, Research Committee, Dr Steve Bradley, University of Wales, and Chair, Professional Policy Committee, Ms Clare Goodess, Senior Research Associate, University of East Anglia, Association of University Teachers, called in and examined.

Chairman

158. Thank you very much for coming. I wonder if there is anything you would like to say by way of introduction to put us in your picture, as it were, other than what will come out through the questions which you have had, I understand.

(*Mr Triesman*) My Lord Chairman, I wonder if I might say a word or two about who we are, which I promise I shall do briefly. My colleagues in the team here today are: Adrienne Aziz, who is the Assistant General Secretary, responsible in the Association for contract research staff and matters associated with them and for our relationship with the Office of Science and Technology; Natalie Fenton, who is a researcher at Loughborough University and one of the two elected officers of our contract research staff; Dr Steve Bradley who is from Swansea, University of Wales and is the Chair of our Education Policy and Development Committee, which is responsible for the professional side of the Association's work; Clare Goodess is the other officer on our Contract Research Committee and is at the University of East Anglia in the Climatology Unit which, I believe, my Lord, you will probably know yourself.

159. Since I am Chairman of their Environmental Committee!

(*Mr Triesman*) Indeed, and it is a centre of international repute. I am David Triesman, the General Secretary of the AUT. My background is that I am something of a hybrid mathematician. My own research was in epidemiology in the British Post Graduate Medical Federation. We are very grateful for the opportunity to come and speak to you and to answer your questions this morning. We are grateful for the attention which you have given to the documents that we have sent. The Association is 75 years old this year. It represents about 35,000 academics and related staff in the "old

[Chairman *contd.*]

universities"—forgive the terminology; I do not know that we have invented newer terminology. May I say that from the outset the founding parents of our Association had two objectives: they wished to have a fully professional body which was concerned with quality issues and with ethics issues and issues of the well-being of universities, of students and of research; and also a trade union which looked after salaries, the conditions of employment, pensions and so on of members. In a sense I think that it is a happy conjuncture that your Lordships are looking at the issue of careers which is a blend of those professional and employment issues. We have a deep concern for the national effort in the area of science research and a feeling that the nation risks lost opportunities, that we find ourselves in a position not because of any malice on anybody's part but out of a relative incoherence, unable to make the best that could be made out of our science resources. Just as a quick example and the last thing I wanted to say by way of introduction, I noted just towards Christmas that David Hunt, when talking about the work of the Office of Science and Technology and launching his project, Prescribe UK, was encouraging links between overseas pharmacological companies and the United Kingdom, a project involving inward investment, and he said that: "United Kingdom science has made a remarkable contribution over the years to people's quality of life all over the world. It has also provided the intellectual springboard for wealth-creating initiatives." During the course of what we say to your Lordships this morning we will feel it necessary to point out the crisis that is about to occur in both chemical and biological sciences which would underpin such an initiative and crises that will occur in the staffing of those disciplines within a matter of a very few years now. So in a way it is mismatch that we feel is the problem that might create lost opportunities.

160. Do any of your colleagues wish to say anything? In that case perhaps we might like to look at the question paper in front of us. The first thing I would like to pick up is your remark that you think the situation has developed in a sense not by any malevolence on anybody's part but by—I think you used the phrase—"relative incoherence". I imagine you meant by that people not getting together to foresee this problem. I notice in paragraph 2.3 of your memorandum you say that one-third of university teachers will be retiring in a decade and you refer to it as a "demographic time bomb". The first question is, quite simply, is that not actually an opportunity? If one-third of the staff are going to leave, and there are 30,000 of them, does that not give us a degree of flexibility and an opportunity for new appointments?

(*Mr Triesman*) I think that it certainly ought to. When we studied the demographic data on the ageing of the academic population, I think we were surprised by the rapidity with which people will be leaving the profession. I must say, and I can certainly provide the data if it is helpful to your Lordships, that the evidence is that the trend is much stronger in some scientific disciplines than it is in others. If we saw good evidence that recruitment policies, whether described as new blood policies or any of the other terms that have been used in the recent past, if we saw evidence that there were such policies or if we saw evidence of consistent succession planning within institutions perhaps we would be drawn to the same conclusion that you have. I fear that we do not and we have tried to model out the points at which the crises will occur in each the major science disciplines as one set of careers come to their retirement point at an average age of 61. That is quite an interesting characteristic; the supposition that people will work to 65 turns out not to be accurate upon investigation. The suppositions, I think, really do lead us to believe that we would expect to see recruitment policies in place now.

161. Could I interrupt you for a moment. Did you say you had got this information subdivided on a subject basis? Drawn from what database?

(*Mr Triesman*) We have drawn it from research which has been commissioned by the Association.

162. In addition to the survey which the Stirling people did?

(*Mr Triesman*) It is in part in the survey which the Stirling people did but also applying some of those data to the information which is produced by the universities in their statistical review. It is possible to plot a curve of a great many of these things. I wonder if it is helpful if I give an example of this.

163. If you could give an example and if the data is what you say it is—and I have no reason to doubt it—I think most of us would feel we would be very glad to have it because we have no evidence yet on real subject differentiation.

(*Mr Triesman*) I thank you for that. I was going to say that the final missing bit of the jigsaw is recent research at the University of Sussex by the Institute of Manpower Studies, and I most certainly will ensure that you have that. But looking at the combinations of the material, particularly the universities statistical review and the Sussex research—and I will run through these, my Lord, if I may—the first example is in biology, where we have found that 40 per cent of the staff have doctorates, where growth in the demand for such staff is said to be slowing. It may be useful if I just say we have been able, or at least through Sussex we have been able, to identify where the graduates tend to go to; they tend to go in biology to the public sector and to university employment, post-doctoral research; where throughout biology those who are partly non-university funded staff are in very much greater numbers than wholly university funded staff; in other words, the university funded staff are the minority in those examples and there is growth in the partly non-university funded staff, who tend to be contract researchers and on temporary appointments. Our view is that the crisis in recruitment, even with the non-university funded staff, will certainly occur by 2003 and that recruitment in the period 1996 to 2003, given the time it takes to train anybody, is a critical period.

Lord Phillips of Ellesmere

164. Could I, my Lord Chairman, intervene for a moment? Mr Triesman, you will know that biology covers a multitude of sins these days. Does that cover, for example, biology on the one end and classical zoology on the other end, or how is it defined?

(*Mr Triesman*) It was defined as the core science of biology in the Sussex research. I would need to check that for you, Lord Phillips, but my belief is that it did not include classical zoology. The research paper itself was not specific on that.

165. So we are talking about people who study molecular, which is certainly very fashionable, and non-molecular aspects of biology all mixed up together?

(*Mr Triesman*) Yes.

Chairman

166. Could I also add another question on this point? Are you leading us towards what I was probably going to ask you, which is the point that since you know the people who are going to retire and the numbers year by year and you also know the number of those contract research staff, are you going to be able to tell us whether there are enough or less than enough people in the contract research staff who could fill those places which will become vacant and what effect, therefore, it will have on the stock of contract research staff, taking into account that there will be more entering that as the years go by? In other words, it is a manpower flow, is it not?

(*Mr Triesman*) Yes, that is right, my Lord Chairman. There is a sort of box in the middle and there are two sorts of flows: the new recruits and contract researchers in at the one end and then there are retirements out and people leaving for other reasons. That indeed is the model. What we know of the contract research staff—and that is the bit from our own research—is that about 27 per cent of them would wish to follow careers in academic life which involved teaching. It is about 45 or 46 per cent who would really rather remain in research altogether. The others do not see themselves as having necessarily a future in the university sector. That will not produce the replacement; indeed, it will produce about half the replacement.

Lord Phillips of Ellesmere

167. I quite understand that doing research alone is a very attractive career but really there is no tradition in the university service for a large cadre of people who are research only until recent years in which research contracts have grown and this cadre of short-term research assistants has grown up. So how reasonable is the aspiration of 46 per cent of these people to have a long-term career in research only, and if they aspire to that, surely they have to look for other places of employment—research institutes, industry and so on?

(*Mr Triesman*) I wholly understand the point. It may very well be that expectations have changed as the growth of contractual research has taken place and that for a great many people who would have looked perhaps, as I did early on in my career, at the relationship between research and going on into mainstream academic teaching, that set of expectations has now changed. We certainly do see strong evidence that there is a group that is very determined, in as far as it can control these matters, to stay in research, wherever it is they then go to do it. It may be they will be frustrated in that objective. That might be the impact of what is being put to me but certainly in terms of what they say their wish is not, in three-quarters of the cases, to go into a post which involves teaching.

168. I wonder to what extent these people receive career counselling, both from their employers and from the Association?

(*Mr Triesman*) We certainly have two colleagues here who, if they received any career counselling, can describe it to you. It does not appear to be a prominent feature of what we found in our research.

(*Ms Goodess*) I am, I think, a fairly good example of somebody who wants to make a career out of research and have managed to do so for the last 13 years within the same unit. There are about 14 people employed on scales 1A and above on short-term contracts in my unit, and of those, eight of us have been employed there for more than ten years. However, I think there is now going to be an element of long-term funding stability and the fact that we have actually been successful in getting that funding—in my own case it has been partly from the European Community and partly from private industry, a combination of those—I think it is clear that the work needs to be done. There is a demand for the work we are doing. The position on training varies from department to department and from university to university. I have had a limited amount but I think later on there are some questions about people on the lower grade of 1B and the fact that probably fewer than half of them, or around half of them, have received training, although it is supposed to be the formal training grade.

Chairman

169. Those are the research students?

(*Ms Goodess*) Some of them are registered as students. Others of them are employed as research assistants, research associates.

170. But only having a first degree or an MSc?

(*Ms Goodess*) Yes, they should only have a first degree.

171. Pre-doctoral?

(*Ms Goodess*) Later on you will hear there are examples where that is not the case.

(*Miss Fenton*) I would just like to point out on the AUT survey that we did come up with a figure that said only 35 per cent of people had been appraised and an appraisal is a very important process in career development in trying to identify training needs. Clearly I think in the majority of cases it is not happening.

Lord Haskel

172. Is that because the institutions do not go in for appraisal or because they have not got the staff to do it?

[Lord Haskel *contd.*]

(*Miss Fenton*) I think it is a bit of each actually. There are not so many people who know what a contract person does in order to be able to appraise them effectively. I think that does result in people saying, "Let us leave it for a little while." There is also this idea that they are transient, therefore they would rather put their appraisal efforts into the permanent lecturing staff.

Chairman

173. Plus the fact of course that there is a long-established tradition of master/apprentice in science, certainly between a research student and the person supervising his work. Their relationship has hitherto been judged, and in my experience has actually been, very intimate and appraisal occurs without any formal arrangement anyway. Would you agree with that or perhaps you are not old enough!

(*Miss Fenton*) I am perhaps older than I look. There is a difficulty with that actually because what happens with the relationship between the supervisor and contract researcher is in fact that it is a relationship of grace and favour.

174. Friendship surely?

(*Miss Fenton*) Friendship? I would love to think so!

Baroness Hilton of Eggardon

175. Chairman, you are the exception to the rule as always!

(*Dr Bradley*) There are three or four points I would like to pick up on, my Lord Chairman. With respect to the numbers of post graduate students who might expect to remain in academe, I think we would like to make the point that universities have expanded tremendously in the last decade and one might expect post graduate work and entry of researchers to match that. I think we are also very much becoming a research-orientated society and one of our great strengths in the past has been research and we feel this is an area where we need to bring on and to advance young and not so young people who are experienced in this area and they are an asset we might look to retaining. I think also there is a very large personal investment in anyone taking up work as a researcher at the end of a PhD and perhaps in post-doctoral work in the sense you have committed yourself to an academic career and again perhaps there is a sort of expectation that one might expect to continue to go on in this area. One of the things that does come through in the area of science employment is the expectation of some reasonable degree of security for someone taking it up as a career and being able to anticipate with some degree of accuracy, provided you are competent and satisfactory, that you can make some sort of career out of it. There are a series of hurdles in the career structure of an academic, depending on whether you are successful with grant or successful with actually getting in work, that would have to be matched. So we would look perhaps to some sort of opportunity for those starting a career as a researcher to have a reasonable expectation of going forward in that way.

Chairman

176. Can I interrupt at this point and rephrase what you have said to see whether you agree with it? Are you saying that in the last ten or 20 years there has been a significant quantitative change in that contract research staff have increased and academic staff in universities have remained numerically the same over the dozen years and therefore there is a need now to recognise and regularise the employment of these people as a career group and to look after them in a proper way.

(*Dr Bradley*) At an impressionistic level I would say yes but I have to rely on my colleagues to give me hard evidence on that.

(*Mr Triesman*) I think, my Lord Chairman, that is a very accurate statement. There has possibly been a slight increase overall in academic staff but generally speaking you have described the picture as we see it.

177. May I just add one further question on question one? Are the Scots ahead of us because, picking up what you were saying earlier on, their Higher Education Funding Council has decided to resuscitate the old premature voluntary retirement scheme in whatever is its new form, plus new blood? You must be aware of that of course, at least your Stirling colleagues will be. What is your attitude to that, do you think that is a necessary development?

(*Mr Triesman*) It certainly would ease the problem which I mentioned earlier of succession planning if funds were adequate to make early retirement a viable option. We believe that the strain on university finances in England and Wales, and probably also in Northern Ireland, are such that they are not at the moment able to do it and the Scottish Funding Council I think is ahead of the game.

178. Thank you very much. Perhaps we ought to go on now to the next section unless you have further points you want to add on one and two?

(*Mr Triesman*) I shall not go into this in great detail but just going through this and taking Lord Phillips' point about the broad definitions of many of these core science areas, if I could just make the point that in the other core science areas, the crisis points which we believe to be there from the Statistical Review suggest that the problem in chemistry will occur by 1998, which is really no time away at all; in material sciences and engineering in 1997; in mathematics it is on us next year in 1996; and in physics again 1998, looking at those flows. To complete the point, in order to keep staffing stock on a level footing with the current stock of scientists, the University Statistical Review appears to us to show that across the years 1993 to the year 2000 there is a need for an annual intake of 11 per cent in order to correct the phenomena which I have just described.

179. Intake into which categories, permanent academic staff?

(*Mr Triesman*) An intake into the permanent academic staff stock.

Lord Phillips of Ellesmere

180. Can I pursue that, my Lord Chairman? On the one hand we have the flow into the system or staff within the system available for academic posts, which

[Lord Phillips of Ellesmere *contd.*]

is a total of 18,000 research assistant staff or something of that sort at this moment, and a continuous addition to that year on year of people qualifying with PhDs of various kinds, 800 in chemistry in 1993. That does not suggest to me that there is a shortage of candidates for these permanent posts, so where do you see the difficulty?

(*Mr Triesman*) I think, my Lord Chairman, the difficulty lies in the probability that we are not going to recruit the people who at least are potentially available. I completely accept that it is a matter of assessment on the given data whether we will succeed in the universities in recruiting but my best guess would be that during the recession the pattern of recruitment was likely to be more successful because of the absence of many other opportunities. If we come out of the recessionary period, that itself will have an impact. The evidence is that even within the period of recession the pool of contract research staff is not, maybe for the reasons of contract that Lord Phillips mentioned earlier, at present willing to take that particular career path. I think Dr Bradley is absolutely right that there are a number of hurdles which during the course of this morning we may be able to describe as to why they look at the world in that way.

Lord Haskel

181. Is the pool that you referred to solely in the United Kingdom or do you look at Europe as a whole or the world?

(*Mr Triesman*) I would dearly love to. The quality of the data across Europe at the moment is difficult to read. The definitions are even broader in their scope than the ones that we are constrained to employ here. I must say to your Lordships that what I have said—and I made the point earlier—is strictly about the old universities. The equivalent data even about the former polytechnics in the United Kingdom is at the very least so sketchy that I could not produce a generalised picture to cover that sector. There is no real continuity in statistical approach.

Baroness Hilton of Eggardon

182. I wish to address the section on career planning and the efforts that have been made to date in trying to develop some rational career plan. I think in 1991 you negotiated the Good Employer Agreement with the universities but you suggest that it has only had rather patchy support from the research councils and elsewhere. I wonder whether you feel that that is something which should be taken up and pursued or whether you feel that that initiative has really ground into the sand and something else is now needed?

(*Mr Triesman*) I truly hope that it has not. In 1979 the funding councils—and I hope none of them will feel it is a patronising comment if I say this—said and believed, as I understand it, quite sincerely that they wished to see better established career systems for researchers, all researchers but certainly including scientists, and by 1989 in our discussion with the Vice Chancellors we made the agreement to which your Ladyship has referred. One of the things which I find disconcerting is that whenever we speak to any of the parties involved they tell us that they cleave to the same beliefs as we do, but what I observe is this, that the funding councils, or at least some colleagues in the funding councils, have said that when the agreement was made with the Vice Chancellors they did not believe that they had any serious input into the discussion, with the consequence that they were to fund the outcome of the agreement without having been a party to the agreement. Often Vice chancellors will say to us that they would love to operate in terms of the agreement which they had made in good faith but the funding councils have not provided them with the money to enable them to do so. What is saddest, in my view, is that we never seem to be able to get all of the interested parties in one room at the same time. It seems so simple. If everybody really believes what they say, as I believe they do, it really seems so simple to have at least a tripartite meeting of the funding councils, including the research councils among the main funding councils (if I can group those together), the Vice Chancellors and ourselves—I think everybody acknowledges that we are the only organisation that represents this grade of staff—and possibly, if the Government thought it helpful, with the involvement of the OST. I think that would be a matter for them to judge. I believe that we would succeed in bringing the agreement into practice, not just in a few universities where we have managed to persuade them individually, but we would bring the agreement into practice in a matter of weeks were we to have that opportunity and it does strike me, my Lord Chairman, that it is somehow an irrationality if that does not happen.

183. Are you saying that its failure is due to a lack of money? That is rather disappointing because one can put in any career scheme without money. I am not clear why the funding councils' role is so vital. Cannot the universities just go ahead and put in proper schemes for the career management of scientists?

(*Mr Triesman*) It is certainly true that some have now started to do so. There is a very interesting scheme at Warwick and we understand that Manchester are contemplating a similar scheme, making the point that if Warwick are doing it and they are a leading research university, then competitors may be leaning to the forces of the market. In those circumstances competitors who want to stay in that league must at least do the same. But it is an extremely patchy picture. I believe there are streams of income which would allow a great many universities to do it but in a sense, to revert to your original question, we would dearly like to see the agreement, which was made in good faith, cover the arrangements that are necessary and we believe that it will do so very adequately. But it will not do so if all the parties stand on their dignity and say, "Well, we weren't involved or somebody else shouldn't have been involved when it was first done." We really have to put that behind us and take the interest in science careers seriously.

Chairman

184. I suspect the universities are not, in fact, adopting that attitude but they find themselves with pockets of money which are earmarked for particular purposes under the present funding arrangements, whether it happens to be from the research councils, from medical research charities or whether it happens to be from the funding councils, and it is subdivided into departments and spending units, resource centres under various headings, and this perhaps, would you agree, gives a degree of rigidity to it which makes it difficult for a single institution to grasp all its moneys and develop a policy in which it can move money from pocket to pocket? Is that your feeling?

(*Mr Triesman*) I think there is certainly a good deal of truth in that and devolved budgeting to cost centres, of course, is a formal reflection of the designation of money for particular purposes within a university. But what I do observe, my Lord Chairman, and I hope it is a view which you yourself would take on looking at the facts, is that the overall income of universities, comprised of a number of different income streams, remains either reasonably constant or in areas of research it grows, and I think that were they to be businesses—I am not advocating that they should be -but were they to be businesses they would have looked at that and said, "We can make fairly safe assumptions across quite long cycles about what it is we realistically can do", and I think that is exactly what has happened in Warwick and Manchester.

185. And with University College London?

(*Mr Triesman*) I was going to say it is certainly starting with University College London, where their scheme is not complete but it looks to be a very, very interesting scheme when it comes about in producing long-term career employment for researchers, and the Royal Society's fellowships were themselves an effort to steer institutions in that direction, and although it is a relatively limited scheme I think it is a very important one.

Lord Dixon-Smith

186. Can I pursue this slightly further? I find myself wondering whether universities are not reluctant to introduce some of these longer-term schemes because they fear that they will reduce what I will call their competitive edge in applying for research contracts and I am not sure whether that will come from the university itself *per se* or from within the university, the individual who is actually applying for the grant. But the fact is that the university world has created a very successful market and I suspect there is a wish to ensure that the volume of the market increases even if, to a certain extent, that might be seen to be at the expense of some of the individuals within it. Is that an outrageous statement or a possibility?

(*Mr Triesman*) I am quite sure that with very much greater competition for research contracts, Lord Dixon-Smith is quite right to say that some universities and some research teams will try to drive down the cost of their bids for the research contracts. The consequence of that, of course, is that no national agreements are ever likely to be kept because people will always have to undercut in order to provide the lowest tender. One of the reasons that we are so eager to see a national scheme is because we believe that that has become thoroughly debilitating. What it has created is a generation of young scientists who are really scraping by year to year hoping that they will stay in science research, many of whom become sufficiently dispirited to leave permanently and many leave these shores permanently.

187. Without wishing to put a value judgment on that statement, is it not better that they should have a job than have a reduced number who are actually in there doing less work but more securely?

(*Mr Triesman*) Fortunately, I think what we can say from what we have now seen of some of the rather better founded schemes is that it is possible for them both to have a job and security on a reasonable and increasing salary. That is within the possibility, the scope, of universities and I think it is likely to prove a disastrously false economy if what we find is that if the very best of our scientists know that they can get that security and that income elsewhere they will certainly choose not to do it in the United Kingdom or in the university sector.

Chairman] Perhaps we can return to that later. I know that Lord Craig and Lord Phillips want to speak.

Lord Craig of Radley

188. Could I, Mr Triesman, take up a point in your submission which is related to what we have been talking about. You say that the convenience of having a workforce that can be dismissed without undue difficulty at short notice is an important consideration, in your judgment, and, as you say, the pattern of repeated short-term contracts demonstrates that it is more the sense of power to dismiss and the sense of control which accompanies the insecurity of others that appears to be at stake. That is a very significant claim. I wondered whether you had any more that you could add to it to substantiate what you are saying here?

(*Mr Triesman*) My Lord, when we did the survey and also in the course of my normal work where I go round universities a very great deal of the time, I do speak to colleagues, some of them members of our own Association and some in senior positions and I would have to acknowledge they do reflect that having the degree of control they do over the people that work for them is a very important factor in the way in which they plan their work and organise their research, so you quite frequently find—my colleague Clare Goodess is an example of a researcher who has been in the same research unit for 13 years, an enormously successful one, and I hope she will not mind my quoting her as an example in this—where it would have been quite realistic, I believe, for people to say even relatively early in the life of that research unit that its prospects are good, its international reputation is outstanding, and it is extremely unlikely after a person has proven themselves in the first few years (we accept of course, there needs to be that) that it is necessary to have short-term contract after short-term contract. The question then arises why are these short-term contracts used in this kind of way? It is not simply soft money. I fear it is because people do enjoy that degree of control and they sometimes will be honest enough to say so.

[Lord Craig of Radley *contd.*]

189. You accept that soft money has a part to play in this but what I was really looking for is whether you had any evidence, other than your considerable contacts, to substantiate the point that there are a number of people being dismissed by their superiors because they have the power to do so and are exercising it in that way.

(*Mr Triesman*) I think that it is not that they are being dismissed; it is that they always have the option of not renewing the contract. What is said is that it keeps the research team on its toes; they are always prepared to work all the hours the Almighty provides and they are prepared to do almost anything because that is the way the contractual renewal takes place. We would like, my Lord Chairman, to see a system which was not based on premises of fear of loss of employment as being a motivating factor.

(*Ms Goodess*) We are actually aware both in the national survey and anecdotal evidence of people taking a cut in salary when accepting a new contract. I think that is a sign of the fear and worry and their desperation. If I could just mention, coming back to some of the earlier points and Mr Triesman mentioned my own personal case, I am actually on my 34th contract now. They have ranged from one month and the longest has been 21 months and I have not had a break in between them because I have managed to bring the money in. The risk involved in giving me a greater degree of security, whether a permanent contract with the normal three months' notice or some kind of rolling contract, would actually be very minimal. My institution has introduced a scheme for rolling contracts for research staff, and a scheme whereby the most senior research staff over grade 3 have been given indefinite contracts but so far only three people, all in my own unit, have been given indefinite contracts and no research staff yet have rolling contracts because of arguments between university and departmental level about the risks involved in underwriting these contracts and who should actually underwrite them. I believe the risks are very low and much lower than the university management would agree. Of course there is the question of the amount of overheads we bring on our contract and what happens to those.

Lord Phillips of Ellesmere

190. Could I follow up some of that? Could you first of all tell us what your area of research is?

(*Ms Goodess*) Climatic research.

191. You did say that, I am sorry. You made some comments which suggested that you are in effect the leader of a team. You talked about "my own unit" and "I brought the money in" which suggests that you have the responsibility for bringing the money in and leading the team. Is that right?

(*Ms Goodess*) No, I would describe myself as a member of a team. I think the majority of scientific work is done in teams.

192. I agree with that but who is the team leader?

(*Ms Goodess*) Okay, in my particular case my team leader is one of the individuals who has just been given an indefinite contract but prior to that was employed for about 15 years on short-term contracts.

193. This team leader had the responsibility for going out and getting contracts?

(*Ms Goodess*) Yes, but it is a shared responsibility.

194. In association with other academic staff?

(*Ms Goodess*) The situation varies. Some funding bodies have rules that will not actually allow people on fixed term contracts to be grant holders. So, for example, we have approached the European Community for money and private industry, then members of the research staff are applying in their own right.

Chairman

195. When this application is made the form has to be filled out which carries the endorsement of the university as owning the premises in which the work will be done, which has to state at some point the person making the application carries the endorsement of the university. Are you saying that endorsement is given to people who clearly are not on any permanent staff?

(*Ms Goodess*) Yes, every application, every proposal goes through the central university administration and is checked but the only time where a person on a fixed-term contract is not allowed to be a grant holder is when the funding body, for example some of the research councils, does not permit them, otherwise the university is quite happy for senior members of research staff to be grant holders.

Lord Phillips of Ellesmere

196. Can I go back, my Lord Chairman, to the point about the sorry problem of the negotiation between the CVCP, the AUT and the research councils. I think that it was the research councils rather than the funding councils that were at issue in this. It was at a time when you may remember I had some responsibility in these matters. I did think at the time it was rather strange that the AUT and CVCP should have gone ahead with a discussion which to their mind involved research council funds without involving the research councils in the discussion then. Having said that, we were told by the OST only last week that this issue was now being taken up again, that the CVCP and the research councils are approaching, with OST agreement, the nature of the document that should be produced as guidance to university managers. Have you been involved in those discussions?

(*Mr Triesman*) My colleague, Adrienne Aziz has been kept abreast of those discussions and I will ask her in a moment, if I may, to comment on those. I think it is fair to say that we have not been present when any of those discussions have taken place and that does concern me very greatly.

(*Mrs Aziz*) That is absolutely right. I have been in close contact with the OST with Sir John Cadogan and Derek Barker and have now made contact with Ann Sharp as well so that I get an all-round view and indeed have given them all the help I can. I have had a number of meetings with them. I am hoping to establish a meeting with the CVCP to monitor the agreement as it stands, which is simply an agreement,

[Lord Phillips of Ellesmere *contd.*]

as Mr Triesman says, between two parties, the CVCP and the AUT. Even that is proving difficult because at the time it was as you say but they are now talking to other parties about what is in that agreement. I would like to reinforce what Mr Triesman said right at the beginning that it really is silly if all the parties involved who have an interest in this cannot get around a table and discuss it rationally because the changing pattern really does mean that agreements of this kind have an unexpected impact on the work of researchers when it is probably least expected and could not have been foreseen even this time eight or ten years' ago.

Chairman] I think you have made your point. Lord Howie?

Lord Howie of Troon

197. You have given us a good deal of information here which reflects well on the professional side of your activities. You talk about breaches of national agreements. You are dissatisfied with the management of the CRS. You find difficulty getting around the table. You give several instances of dissatisfaction among university staff. In the face of this fairly dismal record of events, you seem to have been able to recruit only 23 per cent of the appropriate staff, which reflects not quite so well on the trade union side of your activities. Were you able to recruit more than 23 per cent of the staff it is quite possible you might be able to get round the table. I wonder if you can tell me something about your difficulties and lack of achievement on the recruitment side, by which I mean recruitment to your membership?

(*Mr Triesman*) I think that is a very fair point and it preoccupies us. We would dearly like to recruit and represent a very much higher proportion. That is absolutely right. We have, I think, found two areas of difficulty. The first is that we are increasingly dealing with members of staff who are on very short contracts indeed, some of them matters of just months, and they are in and out of the institutions before we can get to them on occasions. But even more significantly, when we do get to talk to them they are apt to say to us, "I don't know if I have any future here. I'm not signing an agreement to deduction at source or direct debit forms"—the traditional ways of payment of union subscriptions—"We don't know if we have any prospects," and that is something which we have found again and again. I think the second reason is that the extent to which the different patterns of employment in universities have been recognised as a problem which we must deal with organisationally is something which has come to us with greater force recently. Perhaps it should have come to us with greater force rather longer ago.

198. I know the difficulties that you have talked about, but if I can make a slightly unfair comparison, this has been commonplace in the building industry for a very long time and UCATT is always obliged to recruit on every building site when the building site opens up and they lose their members when the building site closes down, yet they manage to attain a certain level. I know this is not a fair comparison. I am just wondering, in the face of your difficulties of attaining parity of representation at these levels of discussion you are talking about, if you were to concentrate more on building up your membership rather than on providing very interesting information, you might be able to have that much greater force in this?

(*Mr Triesman*) I certainly take that point to heart. We do what we can in recruitment terms. It may be that a lot of other unions are more or less successful. Our membership, I am glad to say, grows consistently, but what I do think is difficult is trying to recruit a group of people who are not in general in the same sort of position, as you have quite fairly acknowledged, as those working on building sites, into a professional association when their period at work is often as short as it is. I have noticed that it has not been the proportion of people whom we represent that has been the source of the difficulty. I think Lord Phillips was very fair in saying that maybe the issues at the time of the Good Employer Agreement were not handled in a way which did get all the parties into the room at the same time. It was not that people said we did not have a legitimate role in being there. It was that the construction of the event was probably not right to achieve its objective, though it should have achieved that objective, but that could certainly be repaired now.

199. I would like to press you a little further. I was speaking, by the way, as a member of trade unions for the last 40 or 50 years. I have a great deal of sympathy with you in your problems here but in your evidence here you give a quotation where you say that the AUT is widely perceived as passive. I know you do have a problem where you are trying to combine a professional institutional role, as it were, with a trade union role. That is always very difficult and I think myself always likely to fail. Are you as passive and ineffectual as appears to be widely perceived on page 26?

(*Miss Fenton*) If I can add a point on that, I think a lot of this impression in contract research staff comes from the fact that they are very isolated within their institutions. So they are not considered to be full members of the university by the universities themselves. Therefore they are pushed into the margins of any sort of management structures and developments at all. Therefore then to see this professional trade union as being for them seems to be alien to them, although we are constantly working to try and improve conditions for a group of staff which is very large and has some of the main problems.

Lord Howie of Troon] Yes, but you tell us that the proportion of 23 per cent whom you have recruited among contract research staff is the same as the proportion whom you have recruited among the other staff. So that argument cannot hold too much water.

Chairman] I think we must not spend too much time on this and it is not, I think, for us to resolve your problems, as it were, today, though I am tempted to say if I were in your position I would add the letter 'R' to AUT and make it the Association of University Teachers and Researchers and perhaps

[Lord Howie of Troon *contd.*]

you might have more appeal in those circumstances. But I think we ought to go on.

Lord Redesdale

200. In your evidence in the 1994 survey on page 17 you gave some anecdotal evidence from a researcher who gave the impression that she had actually had to resign because the maternity leave was part of her four weeks' annual leave. The evidence put before us by the CVCP was that they said they had a very liberal structure and gave people as much time as they needed on unpaid maternity leave. Do you think this is the case?

(*Ms Goodess*) I think the position on maternity leave is actually quite difficult to find quantitative information on, partly, I think, because of the problems of isolation that some women face in departments and also because a number of them actually leave. I think the provision of maternity leave also varies from department to department depending on how wealthy the department is, because it is generally the case that the department is expected to underwrite the cost of maternity leave and there are some cases where the AUT supported the introduction of central maternity leave funds within the institution, which I think helped to overcome some of the problems, and the rules of some maternity leave schemes—and I should say that there is not one national maternity leave scheme, there are individual schemes in different universities which vary quite widely and, for example, the rule of some schemes says that the women have to return for three months to qualify for maternity pay but if you are on a very short contract it is actually impossible for you to return for three months, so you do not get the benefit of the university maternity scheme. Just on the basis of anecdotal evidence I think in just about every national or local meeting of research staff that I have attended there has always been some problem raised about maternity leave and sometimes it is a head of department who—

Chairman

201. I think you have jumped ahead rather on to questions 9 and 10, have you not?

(*Ms Goodess*) I am sorry, I thought that is what we were on.

202. Before we do that there is one thing I really do want to get clear, if you do not mind, Lord Redesdale. It is at the top of page 2, question 7[1], which is this question that we have left out and you have reminded us of this, the whole of the new universities. It would be very helpful to this Committee if, from your experience, you could tell us a source from which we might get useful information on them, since I know that many of them are now seeking to build up research groups of one kind or another that did not exist before. Does your corresponding body, the National Association of Teachers in Further and Higher Education, continue to serve the staffs employed by those universities and do they have the same kind of capability of presenting evidence on their research staff as you have?

(*Mr Triesman*) They do represent them, my Lord Chairman, and I would expect that they would be able to present the evidence that is available. I would make the observation that there is, we believe, very little systematic evidence collected in that sector but if any organisation has done the research which would be required it would indeed be the National Association.

203. Thank you very much. May I ask one further question on that. Are you saying it would be useful for us to ask them their views?

(*Mr Triesman*) I would certainly encourage that. I am sure you will be aware it is a very very small proportion of research council money that is at present going there.

204. We are.

(*Mr Triesman*) It may be that early evidence would be more indicative than systematic because there is not yet a systematic body of evidence.

205. If they are going to come into the general pool as the years roll by one cannot ignore them and certainly not in forward projections.

(*Mr Triesman*) I wholly agree with you, sir.

206. We can go back now to Lord Redesdale's questions.

(*Mr Triesman*) Can I add to that by saying we do have with us—I think Adrienne Aziz has enough copies—of the scheme at Oxford that covers their new arrangements dealing with maternity leave which we feel is quite a helpful one and your Lordships might find useful. It is certainly an example of better practice. If I could make the general observation that in contract research, indeed in a great deal of short-term contractual research in universities, including some work by science teachers, it is commonplace to find waiver clauses, clauses where people specifically sign away the rights to various legal entitlements. We try hard to make sure those kinds of clauses are not used in contracts but the effect of it is that accumulated rights in relation to maternity, redundancy pay, all of the things which are time-tied—

207. Who puts these clauses in, the funding body or the universities?

(*Mr Triesman*) They are in the contracts with universities. They do occur in some of the contractual work which is placed by, say, charitable organisations inside universities but our experience is that it is the universities overwhelmingly doing it themselves.

(*Mrs Aziz*) Could I add to that that many women do find difficulty because of the lengthy period of pregnancy which almost always extends beyond the end of a contract and, as several of my colleagues have referred to earlier, the expectation of renewal is not always an easy one. If they are seen to be pregnant they very often fear that there simply will not be a renewal of the contract. For that reason Mr

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[1] The authors of your 1994 *Survey of Contract Research Staff in UK Universities* did not send questionnaires to contract research staff in either the Oxbridge or the new universities. In what ways, if any, does the situation of such staff differ from those who were sent questionnaires?

[Chairman *contd.*]

Triesman was referring to Oxford which is in fact the only university, despite pressure from us on other universities to follow suit, that has indicated—and I am quoting here from its circular—"that women would also qualify for the benefits of the university's paid maternity leave scheme if they can show that either they had entitlement to the benefits of a previous employer's paid maternity leave scheme, or had at or before 15 weeks before the expected date of confinement two years' continuous service with any employer." So this does open up a little window of opportunity for fixed term contract staff, whether they be researchers or indeed in any other grade.

208. Are you saying in a sense you wish that other universities would follow the Oxford lead?

(*Mrs Aziz*) Yes, it just makes the employment conditions and the environment a little bit more humane and lifts some of the pressure.

Lord Redesdale

209. Can I follow on from that? There are obviously some problems with some universities' policy. Would not there be an enormous amount of pressure on the team leader of any group who is actually hiring people to take into account when hiring women—it is going to cloud their judgement—the fact they might go on maternity leave?

(*Ms Goodess*) I think there is a danger of that perception. That was one of the reasons why, for example, at East Anglia the AUT proposed setting up a central maternity leave fund so at least some of the costs of underwriting the cost of maternity leave can be borne centrally so there is no danger of people's judgement, at the back of their mind, being clouded.

Chairman

210. It is often said, you say it yourself, the only option now seems to be abroad and yet I notice somewhere in your report only something like three per cent of them were going abroad. Is that right? How do you reconcile those two statements and do you see any signs of an increasing number of people wanting to go abroad as time has gone by?

(*Mr Triesman*) I think, my Lord Chairman, whilst we had expected in recent years there would be a net outflow there has been some evidence of a reverse brain drain at least in parts of academic life. We believe that that point has now passed. I must say this is substantially anecdotal although it does chime with a good deal of what the Stirling research team did find. What we now believe is happening is that there are a number of specific areas within disciplines where the attractions of overseas contracts are becoming a great deal more persuasive. We can identify those from some of the material that has been sent to us by our colleagues around the country. There are a number of areas in medical research where encouragement, particularly from the United States, suggests that there is very active recruitment or attempts at recruitment of some of our leading teams. A good deal of this recruitment I am told is now taking place in the Scottish universities. In chemistry there is very active recruitment in the European Community of polymer scientists and that has become a very active focus of movement now. There is active recruitment in electrical conductivity in some materials, the creation of images within glass, for example, where I believe there have been successful attempts to get major teams from this country to move to Italy. Most of the movement I have described is movement within the English language world community but there is increasing evidence of it within the European Community. Particle physics, I suspect, is a general problem now because of the capacity of the United Kingdom to sustain significant particle physics research. I think the locations of major centres are now becoming a problem and certainly the United States and Australia are beginning to make very clear enquiries here. In bio-technology I am now told there is a significant attempt to recruit teams to work in areas of bio-technology associated with oil and extractive industries, where I understand—goodness knows I am no specialist in this—that it is now possible to grow various kinds of plant species in the caverns formerly occupied by oil to exert greater pressure on the residual oil and make it possible to extract it. That is a very good example of an industry just offshore from us and very fundamental to our economic well-being where the retention of key scientific teams would be a plain economic asset but where we feel they are being attracted abroad, particularly to the United States.

Lord Phillips of Ellesmere

211. I just raised my eyebrows slightly, my Lord Chairman, at the mention that particle physics was expanding in the United States. I should have thought particle physics in the United States was at least in as awkward a situation as particle physics in Europe and the United Kingdom had been with the cancellation of the super-conducting super-collider. That did not sound quite credible.

(*Mr Triesman*) Again I find it difficult to know exactly why the principal universities in the United States are making an effort in that recruitment area. It may be ill-judged on their part but they are doing so and we see strong evidence.

Chairman

212. I do not think we can really discuss that situation until we have more information and we are, in fact, in touch with the Americans who say that they have similar problems in their universities to those that we have. So we shall know more about those, I hope, by at least May or June. Perhaps we ought to go on. I think we must pick your minds on a question which is of great importance to us, namely do we lose from the system those we have paid for or do those who are lost from the universities go into industry? If so, is not going into industry a good thing and is that stimulation of the relationship between universities and industry where they co-operate not also a good thing? Have you any views on that?

(*Mr Triesman*) I think that we have always believed that there were two crucial things that we

[Chairman *contd.*]

should try to encourage. The first is the creation and sustaining of good research teams in universities, durable research terms, and the second is that that should not be so narrow a view as to discourage our colleagues in research from spending periods in industry, and I am sure that there is a balance to be struck between those. Exactly what all the ebbs and flows are is not terribly well-known. In both the Institute of Manpower Studies report that I mentioned from the University of Sussex—

213. We have that.

(*Mr Triesman*) It is helpful to know that. I think you will find in that that they themselves say that really some more research is needed in order to establish the patterns, but they do begin to. From our own point of view and reflecting on the question that we were also sent in advance, my Lord Chairman, we ourselves maintain obviously our relationships with the TUC and the unions in the TUC. I say that but in a sense it goes without saying, of course, that we do. But we also have a very close working relationship with the CBI and have found that there is considerable consonance between our views, and I think the TUC would probably say the same at the moment, about what is necessary for the United Kingdom economy and how science could be a very much greater asset to the economy, not an artificial agreement but a genuine agreement. If we disagree with the way they approach things I promise you we should say so. We have a growing relationship with parliamentary university and parliamentary industry liaison groups which have been sponsored on a cross-party basis, but Mr Sheerman in the House of Commons has been most closely associated, and Baroness Perry in your Lordships' House. A number of us have played personal roles in some of the seminars and conferences and much of our intention is to show that we are enthusiastic supporters of exchange between universities and industries and we have worked quite closely with Patrick Coldstream in his efforts to make the links in education with business. We publish materials which encourage it. We have been involved in and encouraged the development of science parks as practical ways of doing so, and we have certainly encouraged a number of schemes which have now appeared, including the "Raising our Potential" scheme, which appeared, I think, in February 1994. But there is much more that we could do and I wonder if I might make this observation. I do not mean it to sound complaining or "whingeing" but in the last decade it has certainly not been fashionable for many organisations to deal with trade unions or professional associations. It has been perhaps a neglected resource and we would like to feel we could take a very much more dynamic role than an occasional one, talking with all these various bodies as often as we can. We believe that by taking a more direct part we can encourage the kind of exchange which I think your Lordship is referring to and which we believe is absolutely essential.

214. Thank you very much. Perhaps we ought to touch on the final topic, which is the question of the Master of Research, on which you do know, of course, there is a pilot project or a series of pilot projects. I wonder if you have any views about the progress which is being made there and whether, indeed, you have any cause to revise the opinion which is quoted that "movement towards a four-year norm of research Master's plus PhD has serious implications for the recruitment of overseas students"?

(*Mr Triesman*) My Lord Chairman, I wonder if I might deal with the last point first. Our anxiety about the four-year process of overseas students was that because, for the most part, we are talking about full-fee students, and not people from the European Union who would be—

215. ORS?

(*Mr Triesman*) Yes, indeed. We are talking about full-fee students. There was a lot of evidence from a number of overseas governments and supporters of students that they were feeling the strain of full fees in relation to three years, which obviously is a four over three problem financially if they then have to fund four years, and certainly the funding organisations in governments like Singapore and Malaysia have themselves been expressing their anxiety. We obviously do not want to see those students and, indeed, the income lost to United Kingdom universities. So that was the basis of our concern about the pattern becoming a four-year one. In general we have supported the Research Master's degree. We are very encouraged by the view that it should not be regarded as an automatic thing that everybody should do, that there are other patterns. Direct access into PhDs is also an entirely appropriate mechanism, but we did support it, and do support it, because it seems clear to us that a great many research students have so little guidance in their research methods at the point at which they start that without at least a reasonable input in methodological training, they are likely to lose morale and may very well be lost to the research that they would do.

216. Can I put the opposite point of view which I have often heard expressed, which is that the one thing which a new graduate wants to do is to get on with the research; that is the exciting stuff.

(*Mr Triesman*) I recall it, I believe that that is true. What I think does happen, my Lord Chairman, is this: very frequently people arrive, they have that enthusiasm, they really do want to get on with it, and a few months in they find that supervision is perhaps not as attentive as it might have been because everybody is working under all kinds of pressure; students cannot quite do all the things they thought they would be able to do. Technically they cannot do all the things they thought they would be able to do, and it is not self-evident where they can get the training to make good the gap. I think with a good systematic approach to that problem in advance with some students, by no means all, it should be possible to spot the good student who could really do without it. But with some students it is bound to be an advantage, and it may be that some of those students when they finish the Master's degree, if they go no further they will have something which is a valuable asset in a university career or, indeed, an industrial career.

Lord Howie of Troon

217. Very briefly, you will be glad to hear, earlier on there was some comment about waivers in contracts and I think it was in relation to maternity. Are there any waivers in the contracts we are talking about relating to intellectual property? I have in mind copyright, where there might be, but also the moral right to be recognised as the author?

(*Mr Triesman*) There unquestionably are problems in that area. I am not sure that all of them are expressed in contractual terms so much as in the custom and practice of institutions. We do know, and our colleagues in contract research frequently tell us, that they would conduct work which they would then find appears under somebody else's authorship. They may find themselves as a co-author very far down the list. Maybe that is part of the convention of the team. I do not want necessarily to knock the idea that a whole team might take the responsibility for research publication even if they did not do a particular piece of work, but I think, as we found in medical research recently in some embryo research which is extremely important, those who put their names to the document must have done the research and actually know what it is and whether it is credible or, indeed, that it was even done in the first place. I would make the observation—I do not know whether colleagues have a different view—that intellectual property rights is an area in which very little thought as yet has been given to all those problems in universities and that affects contract researchers. I think it is another area where joint discussion of the issues would be enormously valuable but where, for reasons of territoriality or whatever it is, those discussions have really not taken place, and I think that that is a very live issue.

Chairman

218. Could I enter perhaps a discordant note at this point and that is that my experience has been that the real value of a research group lies in the sense of common participation in a common enterprise and that to over-regulate this relationship with ordinances, with clauses, with waivers and all of that, can be very damaging. I understand your point about very large enterprises, but even so, if science is to go forward there has to be a lot of enthusiasm and give and take on the part of those who are involved in it and a sense of collegiality. Do you not see a danger in over-regulation?

(*Mr Triesman*) I wonder if I could make one quick comment first.

219. Perhaps you disagree with my suggestion.

(*Mr Triesman*) The whole of the notion of collegiality is quite central to our perspective on the life of the universities. What we fear is that too many young researchers, contract researchers in particular, are allowed no opportunity to take a real part in that collegial process. It is a very poor preparation for university life in general if they do not do so. I would just observe, if I may my Lords, that the acute problem is that where you have a combination of no access or little access to collegial processes and contracts which are as insecure as they are, what you have is not the liveliness that you would quite rightly aspire to in all science but a sharp demoralisation, a running anxiety of being out of a job very very soon, fear, and of course that is not the material of which inspiration is made.

Lord Craig of Radley

220. Is this perception of not being part of the university life or college life within the mind of the individuals or are they specifically excluded by university rules and regulations?

(*Ms Goodess*) In some cases.

221. If they are, could you perhaps give us some examples?

(*Ms Goodess*) Again it is an area where practice varies from university to university and from department to department. A number of research staff are excluded from departmental meetings and there it is a matter of departmental policy. For example, in my institution the two main policy making bodies are senate and council. The only way in which I could be elected as member of that is through another body of academic staff called the assembly but the assembly has a rule that you have to have a post that extends a year beyond the date you would take up your position. In the way my contracts have happened I do not think there has been a single point in the whole of the 13 years when I would actually have been eligible to stand as a representative to senate or council. I think that situation is fairly widespread. There are some university councils where there will be some representatives of research staff but I think those are the minority.

Chairman

222. What you are saying is that the group of staff is regarded as transients and therefore as having less rights. Is that it?

(*Ms Goodess*) We are regarded as temporary.

223. That is the same thing, is it not?

(*Ms Goodess*) Yes.

Lord Phillips of Ellesmere

224. Can I, my Lord Chairman, pick up a point which has come up several times in terms of the number of contracts that you have had. If I look at the histogram on page 6 of the Stirling report it tells me that altogether six per cent of contract research workers are on contracts of less than 11 months. The impression that there are many many people on contracts of just a few months is something that ought not to be left with us I think.

(*Ms Goodess*) I think that people have generally assumed that the standard contract is three years.

225. I see 30 per cent have three year contracts on this histogram.

(*Ms Goodess*) There are still a substantial number with less than three years.

226. A few months; one per cent.

Chairman

227. The graph is there and it speaks for itself, does it not?

(*Mr Triesman*) If we have created a misapprehension I would not have wished to do that. I think what we have been trying to correct in our documentation, not just to your Lordships, was the view that all research contracts were three year contracts which has turned out not to be.

(*Dr Bradley*) I wonder if I might make a point which reflects on the query you have raised in the sense of team work and collegiality within research groups. I think it is a sense in which a team leader gives academic leadership with enthusiasm and inspiration but they are now taking on the role as employers and interpreting employment policy. It relates back to the point you made earlier about the ways in which grant applicants may cut corners and the cost of cutting the corners financially is reduced conditions for people whom they employ. Also, many of them may not understand the practices and courtesies that apply to employing people rather than leading them academically, and I think we have very real problems here where heads of department routinely do not understand that they are actually in breach of agreements and we have taken the view in many cases that the college is the employer. I had a dreadful case in my capacity as a local representative where individuals were given new contracts three days before their old ones ran out and the length of contract had been reduced. This is a great discourtesy, not to say a very great difficulty for the people.

228. I am quite sure that sort of thing is not deliberate. It is simply that good researchers are very often amateur employers.

(*Dr Bradley*) Exactly, but it is still a problem for those who are employed.

229. Yes, I accept that, but I think perhaps we ought to draw it to a conclusion. Are there any major points which we have failed to elicit from you in the course of this discussion which you would like to bring to our notice?

(*Mr Triesman*) I would like to mention two things, if I may, my Lord Chairman. One of the questions that you had asked us in advance—it may be you are wholly satisfied that you have the information—was about whether scale 1B was abused or not. I hope you will feel that you have within the documentation the main answers to that, but in essence, just to put them in their briefest form, it is supposed to be a training grade and not that many people on it are getting any training. It is supposed not to be a grade on which people with PhDs are placed but there are certainly some. We are aware of a very, very significant number of people who do not get all the increments year by year whilst they are on the grade. Sadly, it may reflect on the point Lord Howie made to us about our ineffectiveness in a way, but sadly, those people are not always aware of their entitlements. It is a grade which is being used, we believe, not overwhelmingly but in an appreciable number of instances, inappropriately. The second concluding point that I would like to make is about some of the discouragements to pursuing or continuing to pursue a career. One of the key ones, I think, is to do with levels of income. The average income of a contract researcher in a United Kingdom university is a little over £17,000, £17,100. If you look at that in the distribution of the research scales, you will consistently find, if you chart it back over the years, that it is just at the top of the bottom quartile of payments. That is really a matter which does alarm me because I find it so hard to believe that there are not people of sufficient excellence and sufficient numbers in United Kingdom science research as to have justified, to have made their appearance, if you like in higher grades, raising the overall income in a significant way. I am talking about averages. There will, of course, be people above, just as there are people below, but all in all it is a rather depressingly static position and I believe it is because there is not a coherence in the creation of careers, which, of course, is why your Lordships' Committee is so important to us. May I thank you very much for seeing us.

Chairman] Thank you very much indeed.

TUESDAY 14 FEBRUARY 1995

Present:

Craig of Radley, L.	Phillips of Ellesmere, L.
Dainton, L. (Chairman)	Redesdale, L.
Dixon-Smith, L.	
Hilton of Eggardon, B.	Platt of Writtle, B.
Howie of Troon, L.	

Memorandum from the Wellcome Trust

The Wellcome Trust welcomes the opportunity to give evidence to the House of Lords Sub-Committee enquiry into Academic Careers for Graduate Scientists. This is an issue which the Trust regards as of great importance: it is also relevant to most of the Trust's support for research in the United Kingdom. The Wellcome Trust is concerned about the preponderance of short-term posts in universities which has created an unstable research environment, inimical to the long-term thinking and experiments which should drive scientific enquiry. The Trust is very worried that the increase in the number of short-term posts may discourage young and talented individuals from considering scientific research as a worthwhile career, and that such arrangements may stifle the career development of young scientists.

The Wellcome Trust was founded under the will of Sir Henry Wellcome who died in 1936. The objective of the Trust is to promote research in medicine, related basic sciences and other subjects which have the potential for improving health and welfare. In seeking to achieve this, the Trust's strategy is to strengthen the capacity of individuals to pursue their research to the highest standards by providing them with the necessary resources, career development, training opportunities and other support. The Trust expects to spend in excess of £200 million on medical research in 1994–95.

The Wellcome Trust views the future of scientific research in the UK with mixed feelings. On the one hand there is excitement about current research discoveries, and optimism that new research directions will lead to revolutionary improvements in the quality of life. On the other hand there is great concern about the mismanagement of scientific personnel and that without a resolution of this, the considerable intellect of the UK research community will not be exploited efficiently. The Association of University Teachers (AUT) recently commissioned a survey of contract researchers. This concluded that quality research output is produced in spite of the system rather than because of it.

The Problems of the Current Career Structure

Almost half of the academic scientific staff in long-established universities are in short-term posts which are partly or wholly funded from sources other than the relevant Higher Education Funding Council (HEFC) grant. Whilst there has been a recent increase in the number of those who hold posts in universities and who are trained in the core sciences, this growth in number is almost wholly accounted for by an increase in the number of those who are employed on short-term contracts. In contrast, the numbers holding established posts has fallen slightly. An apparent growth in the size of the potential research base may seem welcome, but pleasure is dispelled by the realisation that it is the already high number of well qualified individuals (normally in their most productive years) with no permanent job that has been increased. Of special concern to the Trust, is that the biological sciences have a larger proportion of short-term posts (grant-funded staff are in the majority) than the other sciences, and has seen an above average growth rate in the number of these staff funded from outside normal university resources. (22 per cent increase 1989–92; Source: University Statistical Records/Institute of Manpower Studies).

The current pattern of contract staffing in universities has been recognised by the Government as a matter of concern (sections 7.26-7.31 of the White Paper "Realizing our Potential"). However, the Government has also pointed out that the movement towards employment of staff on short-term contracts is not unique to the universities. The Trust views as unfortunate the comments made in paragraph 7.27 of the White Paper that "this can be productive" since "it provides employer and employee with greater flexibility and encourages more mobility between employers and betweeen sectors". The Wellcome Trust hold the view that mobility of scientists between different institutions is undoubtedly important for the dissemination of ideas and skills both within and outside scientific research. However, this mobility should be driven by scientific needs and be appropriate for the career requirements of the individual. In the opinion of the Trust, a number of important issues concerning health and quality of life require high quality, basic research, which in turn requires long-term planning. It is quite unreasonable to expect young scientists to take a long-term view, when the quickly-recycled need to justify further personal funding forces them to take the short-term approach. The AUT survey of externally-funded research staff in UK universities reported high levels of job dissatisfaction, poor morale and insecurity. The prospect of working on a number of short-term contracts may discourage talented individuals from embarking on a scientific career; planning for a home and family, or taking on long-term financial commitments is not possible with an uncertain future. For the established scientist too, their work may be curtailed because of the ever present instability and constant need to recruit and train new staff. In such circumstances it is easy to envisage how research funds are not being put to best use and thus how the move towards employment of staff on short-term contracts can be counter-productive.

The short-term contract has a place. In the Trust's view it should be used to support those who are in the early stages of a scientific career and who are still able to move between "sectors". The three year project grant is a flexible vehicle for funding hypothesis-driven and focused projects addressing specific research questions. It is not an appropriate means of continually renewing the contracts of highly qualified scientific staff. In the Trust's experience this often seems to be how it is used. The Trust is particularly keen to address this problem, and this is why it has set up its career development scheme for non-clinical scientists.

The Trust's Career Development Scheme

The Trust launched its Career Development Scheme for Basic Scientists in 1993. It is relevant to many levels of an individual's progression in biomedical research. It starts with the provision of vacation scholarships which are awarded to undergraduates reading a biomedical subject. These have the dual aims of giving young people a taste of what life is like in a research laboratory, and motivating those who find they have a thirst for scientific enquiry to undertake further scientific training. For post-graduate scientists, the Trust provides well-funded PhD research training grants. At the post-doctoral level, Research Career Development Fellowships (40-50 per year) provide important opportunities for the Fellows to gain independence as research scientists. For those who have established an impressive track-record of independent research, Senior and Principal Fellowships are provided, enabling the best biomedical scientists to remain fully active in research—in some cases to retirement. The level of investment by the Trust in career development in universities is substantial, representing about 30 per cent of the total money committed each year to funding biomedical research. The Trust cannot however deal single-handedly with all the problems of career insecurity in biomedical research by providing careers for life for a sufficiently large number of scientists. The Trust's aim therefore, is to focus on providing career development opportunities at the stages of an individual's career when they are most needed. This is achieved by recognition of the research contribution and potential of named individuals, by paying them an enhanced salary, by funding their research to a proper level, and by supporting them for four, five or 10 years at a time, as appropriate.

The Trust is moving to a situation where a greater proportion of its grants are funded for five years. The Trust was supporting over 3,000 research posts in universities in October 1994. Of these, 92 were Fellowships of five or 10 years duration for independent research scientists, about 800 were for scientists (mostly non-clinical) in research training positions, and 800 posts were scientific staff on long-term grants—five years, potentially renewable. Of 300 technical staff supported by the Trust, 120 were employed on grants of five years duration. The remaining positions (*ca.* 1,000) mostly employed post-doctoral scientists on grants lasting three years. However, it is estimated that two-thirds of those supported in this way are under the age of 31.

Careers of Scientific Support Staff

The Trust is also concerned about the career structure of technicians. The lack of adequate career provision and remuneration of these individuals has probably led to the current paucity of career technicians in universities. It seems clear that with the increasing technical sophistication of modern research methods, steps should be taken to encourage those with technical skills to join research teams for the long-term. There is evidence that hitherto the "gap" in technical assistance has been inappropriately filled by employing an increasing number of short-term, grant-funded research assistants. The Trust applauds recent efforts by some universities to reverse this trend.

What else needs to be done?

The responsibility for considering the employment arrangements for those on short-term contracts funded by non-university sources rests primarily with universities; they are the employers. The Trust is therefore particularly keen to address the careers issue in partnership with the universities. Universities must bring on stream their own career development schemes and improve their ability to manage human resources. Due and equitable consideration for appointment to suitable vacant full-time posts must be given to those who have been employed on more than one short-term contract. Similarly, career advice should be available that encourages those with little prospect of a career in scientific research, to seek alternative employment. The Trust applauds the efforts of University College London in instigating a career scheme along these lines. The Trust is also pleased to note the initiatives taken by Imperial College London and the University of Warwick in offering Fellowships to relatively young post-doctoral scientists with an expectation of appointment to a permanent post at the end of the Fellowship. The Trust will watch with interest how the research councils adapt their grant-giving mechanisms to help universities improve the career opportunities of research staff and how information on the receiving institutions' personnel policies are to be used (paragraph 7.31 of the

White Paper). The Trust has intervened on behalf of research scientists supported by Trust grants when it has not been clear that a short-term post-holder has been given equality of career opportunity by the university employing them. This policy will be maintained.

The Trust believes that its Career Development Scheme for basic scientists is a significant step in the right direction, and would encourage other funding bodies who are able to do so, to follow suit. In addition, the general move towards longer-term funding is believed to be right. The Trust is concerned that a culture has developed whereby funding science in three-year blocks is seen as the norm, and even virtuous. This has affected recommendations made during the peer-review process, and five years' support is often seen as the rightful property of only the high-flyer or the eminent. The Trust is keen to get its view across to the assessors of science that it is intent on changing this belief.

The Trust notes that academic salaries have increased less in real terms compared to other non-manual staff—including medically qualified personnel. Closing this gap would be desirable as an added incentive for non-clinical scientists whose research activity underpins medical advances.

THE GOVERNMENT'S MASTER OF RESEARCH (MRES) DEGREE

The Trust, along with many others, sees little to commend this scheme. It is the Trust's expectation that, in the biological sciences, potential employees will not come to recognise the MRes as a significant qualification. As the Royal Society have said, students leaving education with an MRes may be left with the need to justify a lack of a PhD.

The quality of PhD training needs to be improved. There is a widely held view that UK postgraduates are given too narrow a training, and are not fully prepared following graduation for life within, or outside, scientific research. Employers in universities and the private sector see the need for more formalized training to enable those qualifying to have a broader overview of their chosen disciplines. The MRes has little prospect of tackling this. The Trust expects little interest to be expressed in a one-year general reseach training course, which will offer a meagre stipend.

The Trust is disappointed that the Government has overturned attempts by the Medical Research Council and the Biotechnology and Biological Sciences Research Council to set up four-year PhD training courses in the biomedical sciences. These courses would have incorporated means to train students in a wider range of scientific skills, as well as specific non-science abilities—such as communications skills. These are often sorely lacking in British scientists. Universities have expressed considerable irritation and disappointment at having invested much time in preparing applications to find that their preparative work has been to no avail due to an apparent vacillation in official circles.

The Trust supports a four-year PhD training scheme at the University of Liverpool. The course entails an initial year of laboratory rotations during which students are being taught a wide range of scientific disciplines. They will be encouraged to play a significant role in devising their own research training projects. The course organisers were very pleasantly surprised by the high interest, numbers and academic quality of those who applied for the studentships offered. The students themselves welcome the arrangements, and there are hopes that they might generate truly novel ideas.

The Trust sees the training of the next generation of scientists as a priority. Moreover, as 43 per cent of those established university funded staff who are qualified in the core sciences are now over 50 (within 15 years of retirement), it is important that the level of funding and the nature of the supervision provided for those currently training to become research scientists recognises this future need. The Wellcome Trust pays a realistic stipend to the students it supports: it is higher than those provided by the research councils. The Trust (it seems uniquely) provides a realistic level of funding for the cost of the research—10 times the Research Training Support Grant (RTSG) paid by most of the research councils. The Trust organises and hosts a residential course in science communications skills for students it supports. This is consistent with the Trust's determination that an understanding of science should be better communicated between scientists, and between scientists and the general public. If the Government is seriously concerned to attract the best quality young people into postgraduate training schemes it needs to:

1. Allow the research councils to raise the student stipend to a level akin to that paid to postgraduate research assistants.
2. Encourage, and at least not stifle, the plans of universities and research councils to test novel training schemes, which have the potential to build on best practice, and introduce broad and transferable skills to those intent on training for a career in research.
3. Facilitate the funding of the RTSG to a level which is sufficient to meet the real costs of training.
4. Not necessarily require that all Research Councils have identical training schemes: since the training needs of biomedical science are not the same as other scientific disciplines (for example, chemistry).

All this is far more important than the introduction of an entirely new qualification, which is unlikely to have impact on the properly diverse training systems already in existence.

CAREERS FOR WOMEN IN SCIENCE

Women make up almost half of all science graduates, yet they make up only 16 per cent of non-clinical academic staff in science departments and fewer than three per cent reach professorial level. The Wellcome Trust's opinion is that this is a waste of skills and a lost investment in training. In recognition of this, the Trust has carried out a pilot survey of attitudes in male and female under-graduates to seek out possible reasons for this inequity. The findings confirmed that most women and men were motivated to study science by their interest in the subject, and the majority wanted a career in science. However, poor conditions of employment and an uncertain job market were seen as factors making a research career an unattractive proposition. Women, more so than men, thought that scientists worked inappropriately long hours, and that the enforced nomadic lifestyle was not compatible with a stable family life. Contrary to expectation, there was no evidence of active discouragement from tutors whilst training, although many women claimed difficulty in being taken seriously in a male-dominated profession. Women are amongst the ranks of those (others being part-time and older research staff) who report being the principal victims of inequality of opportunity, both between contract researchers and other academic staff, and within the realms of contract research itself.

Sexual prejudice is seen by women as a factor in their under-representation. However, a major disincentive may be the perception of current research practices, which make a scientific career unpopular for both sexes, but discourages women more than men. Therefore, to recoup some of the lost investment in training this half of the scientific workforce, it is necessary to tackle the issues of career insecurity as highlighted above. To facilitate the emergence of women in science will also require the more widespread provision of part-time working and career breaks, as well as opportunities to re-enter a scientific career path after a period away from research.

The Trust's science-funding mechanisms recognise this. All research posts supported by the Trust can be occupied part-time. Also the Trust has recently set aside £2.5 million each year for Re-Entry Fellowships in which Fellows who want to return to a career in science are re-trained over a period of four years. During this time a Fellow is provided with the opportunity, supervision, and resources, to empower him or her to regain their former status as a competitive and independent researcher. These Fellowships are not reserved for women but are expected to be of particular value to anyone who has taken a career break from scientific research to raise a family.

Supplementary memorandum from the Wellcome Trust on University Awards

The Trust is prepared to help strengthen University Departments by providing funds to enable them to make a proleptic appointment to the established staff.

Sometimes, for lack of a staff vacancy, a university finds itself unable to recruit or retain a member of staff who is outstanding in research. In such cases the Trust is willing to entertain an application to supplement or provide a salary for up to five years. Support under the scheme is available at all levels from lecturer to professor.

Candidates are nominated by the Head of the Department concerned. Applications have to be supported by an undertaking from the Head of the Institution, the Vice Chancellor or Dean or someone of equivalent standing guaranteeing that the individual's personal support will be taken over by them at the end of the Trust grant. If the institution wishes to insist that the final commitment to take over the funding of a university award holder is contingent upon a progress review, the Trust should be involved in this review. During any such review the Trust would wish to be able to compare any decision not to take over the salary of an individual funded by the Trust under the University Award Scheme with decisions being taken on renewal or termination of the salary of other members of academic staff of the same institution.

Decisions on application under the scheme are made on the merits of the research involved. Normally the candidate will be interviewed at the Trust. The awards provide the candidate's full salary for three years, 50 per cent of the salary in the fourth and 25 per cent in the fifth year and may include some support for the candidate's research programme.

Examination of Witnesses

DR J JULIAN B JACK, Chairman of the Scientific Committee and Deputy Chairman of the Wellcome Trust, reader in cellular neuroscience, University of Oxford, DR BRIDGET M OGILVIE, Director, and DR DAVID GORDON, Programme Director, the Wellcome Trust, called in and examined.

Chairman

230. Thank you very much for coming. We are delighted to be able to see you. We are most grateful too for your letter and the annex. The letter shows only too clearly how strongly you feel about this particular issue. Therefore, I should like to invite you to say something if you would like to by way of introduction to amplify or to elucidate what is in your statement if that would suit you. I should add that we do have a copy of the Stirling University

[Chairman *contd.*]

report commissioned by the Association of University Teachers, AUT, to which you make reference in your document. I think that I ought just to put your mind at rest. There is a typing error in the list of questions which you have had. It is question No 11, "women in non-clinical science reach *professorial* level". I hope that that has not misled you.

(*Dr Ogilvie*) No, my Lord Chairman, we assumed it was a typing mistake.

231. Dr Ogilvie, I take it that you are the leader, as it were?

(*Dr Ogilvie*) My Lord Chairman, we are delighted to come and talk to you all because the whole question of careers and career development is one that the Wellcome Trust has always had a particular interest in. The three of us represented here I think take this as probably our highest priority. We are all very concerned to look after the people whom we fund as far as we can, albeit at one remove, because of course everybody that we fund is a member of the university staff formally so that we work in partnership with the universities and that is our general style of operation, as many of you would know, my Lord Chairman. We have been increasingly concerned, of course, at the ever increasing numbers of people on short term contracts, particularly I think in the biomedical sciences in the universities, and as we have grown over the last few years we have redoubled our efforts in terms of training. Now we have come up with what we think is a reasonable career structure for the staff, both clinical and non-clinical. Perhaps my colleagues might like to add to that general remark.

232. Is there anything that you would like to add, Dr Jack?

(*Dr Jack*) My Lord Chairman, no, I do not think so, apart from of course just noting that the kind of situation that we reported about the proportion of university staff over 50 has existed in some form or another for quite some time but that our concern in noting that relates to the fact that we feel now with the much larger proportion of people that we are funding, with the growth of our funds, that we have to be much more active in encouraging universities to be more responsible jointly with us in the management of such staff.

233. Dr Gordon?

(*Dr Gordon*) I have nothing to add at the moment, my Lord Chairman.

234. May I just ask a question which is down on the paper but which comes directly to what you have just said, that is, when you make a grant to an institution are the people who are employed on your terms or on the university's terms? Do you make a grant to the institution? Is that the legal employer which therefore has control of the terms?

(*Dr Ogilvie*) That is the case, my Lord Chairman. Our grants are to the universities and the universities employ them and therefore they are subject to the terms and conditions of the university. We do from time to time intervene but bearing in mind that we fund non-geographically, so to say—we have about 70 institutions that we give grants to, of one sort or another—we have therefore in general terms to abide by their terms of employment. But of course we do actually pay our staff rather more, particularly the graduates, than the average going rate. We do that really because everybody the Wellcome Trust supports is on contract; they do not have an established post, and we feel that those on contract are living a more dangerous life and therefore should be paid a bit more. That applies not only to the absolute stars who win fellowships and the like but also to support staff who are graduates.

235. To get this absolutely clear, the university or the institution—it may not be a university—sets the terms and conditions in the sense of, what, tenure, lack of it, period of contract?

(*Dr Ogilvie*) The tenure would be related to the length of the grant, normally speaking.

236. Yes, well, you have a grant with the university, but the university has a contract with the contract research staff, but you say that you are able to intervene and you award salaries which are larger than what would normally be the case in the university? Does that create problems within the university?

(*Dr Ogilvie*) No, I do not think so, my Lord Chairman. We have not particularly had difficulties of that sort.

(*Dr Jack*) Perhaps I might just add, my Lord Chairman, as someone working in the university who sees it from the other end as well, there are problems. The problems are greatest or have been greatest with the doctoral students. The basic view that the Trust has taken overall in its policy is that it would prefer to have its scientists being trained and paid adequately at a satisfactory level and if necessary support less doctoral students. When we first introduced the Prize Students Scheme, of the trust, they were funded at nearly double the level of the research council stipends and that did of course create problems and some jealousy. With respect to post-doctoral scientists to whom we do pay more—and we have persuaded in recent years the university to accept that we should pay two or three increments above the standard national scale—in those cases the problem is less because of course the differential is less than it has been in the past for doctoral students. On the other hand, however, it is certainly true, if I may speak as a person who is heading a research group, that those of the post-doctoral scientists in my group for whom I might be seeking renewed funding would far rather that that funding came from the trust so that their salary remained at the higher level, so these are problems. These may be minor problems, but they are still clearly there, and it is I think one of the difficulties about the Trust policy in trying to pay what it regards as a more satisfactory level than the national academic scales that we do create tensions because of that differential.

Lord Dixon-Smith

237. If I may just pursue that a little further, my Lord Chairman, the trust it seems to me is an enormously generous and beneficial body in this field, but if there is not a tension within the universities, then somewhere in the trust there must

[Lord Dixon-Smith *contd.*]

be a tension between establishing the levels of salaries that you are prepared to award, if you like, and the volume of work which you would actually like to undertake. How do you resolve that?

(*Dr Jack*) In discussion at meetings, my Lord Chairman, particularly the scientific committee, but in fact I do not think that there is a great deal of tension about that. The kind of extra remuneration that we offer the contract research staff is still a relatively small percentage and we do have a very clear commitment—and I think that this is absolutely unanimous among the Governors and the scientific staff of the Trust—that at the moment, contract research personnel are not paid as well as they should be. We have noticed, of course, the relative reduction in those salaries related to the academic pay scale, compared with the national average wage or gross national product in the last five to ten years.

Lord Phillips of Ellesmere

238. I was told the other day, Dr Ogilvie, that you were going to discontinue support for graduate students. Is that true?

(*Dr Ogilvie*) That is not the case, my Lord Chairman. We are changing the way in which we are going to give support for graduate students. We have in the last few years had a quota system which we allot to universities and we have decided for a number of reasons to change the way in which we award our students. We are certainly not discontinuing it.

239. Perhaps I may then ask another question, my Lord Chairman. One of the causes for tension to approach it in this way in the university system when I was a part of it was the use by the Medical Research Council of the researching units which enabled them to implant in the university a laboratory which they managed themselves and which employed their own staff. Those staff were also paid somewhat more than corresponding university staff, hence the tension. Nevertheless those units were in my view very often very successful in terms of the research that they produced. Have you ever contemplated adopting such a system yourselves?

(*Dr Ogilvie*) No, we have not actually. There are many inequities in pay within the University system. The greatest is the difference between clinical and non-clinical salaries, and I think that that causes real tension, but that is not just applicable to the staff funded by the Wellcome Trust. When you have non-clinical staff working closely with clinical staff, particularly those who do not have a large clinical load, or any clinical load, but are paid more, I think that creates real tension.

240. On the point of units, have you contemplated units and, if not, why not?

(*Dr Jack*) We have discussed it certainly in the past and decided certainly not at the moment to proceed in that manner. I think that there are two issues, or three, about units. One of course is that they are within the university but administered by the funding agency. At the moment we do all our funding through the universities and we have not yet thought of abandoning that, but we would probably have to if we did go down this route. The second thing is that in the Medical Research Council units, staff have effective tenure up to certain periods of time, whereas at the moment our career structure provides fellowships which start off being shorter in duration and become increasingly longer. We have never made the commitment for someone, say, aged 30 to 35, that we will then support them through to retirement in a single move. Then the third thing is the issue of remuneration. If we did go to units, clearly we could pay a lot more if we wished to but even with those of the scientists that we support in the university system higher grade, our so-called principal research fellows, they often are paid substantially more, and the universities sometimes with some reluctance come to accept that higher pay.

Lord Craig of Radley

241. My Lord Chairman, the Trust's career development scheme is clearly a very important part of the Trust's future thinking and you are moving more towards five year contracts or funding of five year contracts. Looking at your very interesting paper on this would I be right in assuming that still about one third of those you support are on three year contracts whereas the rest are on five or longer. I wondered how you see that as a sort of steady state or whether you felt it was not because there is a reference earlier in your paper to a wish or a view of being able to provide careers for life; the two do not quite hang together? It would be helpful if you could just separate the two so that we can understand your thinking.

(*Dr Gordon*) My Lord Chairman, I will try to deal with the point. Yes, it is true that about one third of the staff funded on grants are on three year grants. We are not in a steady state, and I hope that we are evolving towards a situation where more of the science is funded for five years and in the case of the more senior people in their careers to give a guarantee of support for ten years. Of course, there has to be a balance between the need to give people security and the way that science can move very rapidly. One does not want to be committing to a particular project for a very long time if that area is going to move on within two or three years. There is also, as we say in the paper, the point that most of the people on the shorter term contract are the more junior ones, in other words, these are people who have completed their doctorate and they are in their first or second post doctorate appointment and they are at the stage where it really is useful for a young man or a young woman, having gained experience in one laboratory doing a PhD, perhaps to move on to another and then perhaps to another with all the skills that they have gathered from those different places before settling down to a more concentrated and long term period of work. That is why within the trust's portfolio of career development awards at the intermediate stage someone can come in for a fellowship for four years when they are starting to make their name and then later as a senior fellow for five years with the possibility of renewal at least once. So, yes, my Lord Chairman, there are tensions between those two sides and we are in an evolving

[Lord Craig of Radley *contd.*]

situation. We want to evolve to a situation where staff have better conditions of employment and more security in what they do without destroying the flexibility that I think is essential for any kind of original work.

242. So I think perhaps the Committee can take from that that there is no universal wish on your part to do away with some short term contracts and they have an important part to play at least from your point of view in the early stages of a research scientist's career?

(*Dr Gordon*) Yes, I think that that is true, my Lord Chairman. It goes back to one of the points that my colleagues brought up earlier on in response to Lord Phillips' question about studentships. There is a change in the way that the trust funds studentships. It does mean a modest reduction in the number of studentships, but I think that we all of us within the trust feel that it is often best for science to do perhaps slightly fewer things, fewer grants, but to do them better, and for anyone at any stage in their career it is important to have the work really thoroughly funded so that they do not have first to get their fellowship and then support for the research and then wonder whether they have got somewhere to do it but to be able really to settle down and get the work done in a concentrated way, so, perhaps sometimes fewer people, but properly looked after.

Chairman

243. This is an implied criticism of the situation as it exists in the public sector funding of scientists, is it not?

(*Dr Jack*) My Lord Chairman, with respect to the behaviour of the Medical Research Council I think that—

244. I am sorry, I did not ask you that, Dr Jack, I asked Dr Gordon because it is quite an issue here, is it not? You have fewer but better people on the one hand—I think this is what you are saying—with better career prospects and more committed therefore to their work?

(*Dr Gordon*) I would not, my Lord Chairman, want my comments to be taken as an implied criticism of any particular body or group of bodies. Many organisations I think work with constraints that the Wellcome Trust is mercifully free of. For example the trust took the lead some time ago—Dr Ogilvie was leading in this particular activity at the time—to look at the way in which fellowships were funded by many other bodies and to suggest in discussion with them that it would be inappropriate for one charity just to provide the salary of research workers and then for those research workers to have to go and set out and find their research funding from the Medical Research Council or the Wellcome Trust or elsewhere. There are some other foundations that as a consequence of thinking this issue through decided to make slightly fewer awards but to make sure that they are funded more completely. But it is not meant as a criticism of any particular group.

245. You mean that there are many patterns which are possible and appropriate?

(*Dr Gordon*) That is true, yes, my Lord Chairman.

246. May one perhaps come back to the main issue—I led you, I am afraid, slightly astray—that is, that while in the last ten or 12 years the number of staff in established university posts has remained constant and universities have expanded, the contract research staff has increased by a factor of about two and a half, and you express very great concern about that; I think you say that it creates an unstable research environment and you are worried that that increase may discourage young and talented individuals. Would you like to expand that? You do not give us any evidence for the instability or for the anxiety and worry and discouragement. Do you have evidence on that, on either of those two points?

(*Dr Gordon*) My Lord Chairman, if I may deal with that point, concrete evidence is very difficult to gather. It is like a question that I know that you have in mind to ask us about later on about the perception of the nomadic lifestyle. These are perceptions that people have.

247. How do they come to you?

(*Dr Gordon*) If anyone were to sit behind my desk from day to day, one meets individuals who have a very sound record in research and they have got good ideas that will survive in the peer review system. However they as individuals say that they are not certain that they want to carry on because of the uncertainties and the doubt whether they will actually be able to make a real career in the system. Doubts whether you will succeed in your career are common in any profession, of course. I suspect that they are rather more common among scientists than, say clinicians—and I see clinicians interested in research: perhaps they have a little more confidence because they have a safety valve in moving into health service work. So it is a perception, my Lord Chairman, it is a thing that we say from day to day. I cannot quantify it.

248. May I ask, are they looking for an established post in the university, most of them, if they are not medically qualified and therefore not looking to the National Health Service?

(*Dr Gordon*) Very often in the long term they are doing so. We also of course see people who are at a point in their career where they are deciding—they do have the opportunity of an established post in the university, but this might make it more difficult for them to concentrate on their research, it will give them extra responsibilities that they might feel that they did not want to take on, and not infrequently we find these individuals if they really have confidence in their ability deciding not to take an established post and coming in to the Trust or to the Medical Research Council or the Cancer Research Campaign for a senior fellowship or similar high level award that will allow them to have themselves funded externally and give them the freedom to continue their research.

249. Do you think that this situation can continue? I only had on my desk today a letter from the Committee of Vice-Chancellors and Principals pleading for further expansion of the university system. I do not know whether they were well informed or under an illusion that with that would come resources that would enable them to expand

[Chairman *contd.*]

the university established staff which in a sense would go towards solving this problem. It seems to me that it is rather unlikely, and this brings one back to the problem of, assuming the system to be static, when do you think that there will be some loosening up as people drop off the end at retirement or even early retirement?

(*Dr Ogilvie*) Perhaps I could make a comment there, my Lord Chairman. I think that part of the problem comes from the enormous pressure on the universities to produce more and more research, to produce more and more teaching, and to produce more and more of everything. That is reflected in our activities by a huge increase in the number of applications that we have to process. As our funds have gone up the percentage success in awarding rate has dropped so that we now process four or five applications to make one award, whereas when we were much smaller we processed three to make two awards. So there are all sorts of forces that are operating on the universities which then impinge on us.

250. Are those forces due to the nature of the formula funding which comes to them from the funding council primarily—let us say there is an assessment of research—and are you saying that assessment is based on quantity rather than a real assessment of quality?

(*Dr Ogilvie*) Certainly the requirement to perform is pressing the universities. As to whether it is quantity or quality, it is supposed to be quality, but the effect on all funding organisations, whether it is research council or charity, is to receive more and more applications because I suspect that the vice-chancellors feel that the more applications they have safely funded, the better their research rating. One assumes that it is quality because certainly we feel—although it is always very difficult to make a judgment—that our quality has not gone down. The judgment of the peer review process has got tougher and tougher in my view as our funds have gone up.

251. Has the success rate gone down? You said the applications had gone up.

(*Dr Ogilvie*) Oh, yes, right down, my Lord Chairman.

252. Gone down significantly?

(*Dr Ogilvie*) Oh, yes, down to about 20 per cent.

253. From what was it in the better times?

(*Dr Ogilvie*) Between 50 and 60.

Chairman: A major change.

Lord Dixon-Smith

254. My Lord Chairman, perhaps I may pursue that. If the success rate has gone down, yet if we look at what the Trust is doing, the Trust clearly in purely monetary terms has increased its funding, and I am not going to argue about it in real terms because I have not done the calculations, what you are implying surely is that the supply of if you like researchers, or the people who want to do research, has increased and presumably the initiative for that has come from the universities for whatever reasons we have already been discussing, volume of research, and we are back into qualitative analysis of the universities themselves who feel that with quantity goes perhaps a higher qualitative assessment at the end of the day?

(*Dr Ogilvie*) That is what we think has happened, my Lord Chairman, but it is very difficult to prove.

Chairman

255. Given something like this to be true for argument's sake, and then expanding the universities by a factor of two, as has happened recently, that is to say, they are all now funded by the same funding council with the same criteria, is that not going to add enormously to the demand for new universities to get brownie points in cash from research, and what is your judgment of that as a good or a bad situation?

(*Dr Ogilvie*) My Lord Chairman, I do not think that we have a view. Most of the new universities do not actually do very much research in the area that we fund. Whether they wish to I do not know, but certainly we would expect people to compete across the sector.

Lord Dixon-Smith

256. My Lord Chairman, may I ask the reciprocal of that. You said, whether the new universities would wish to—would you wish to fund them if they came to you?

(*Dr Ogilvie*) Oh, yes, we accept and fund grants whatever universities they come from if they can win in competition.

Chairman

257. I see that both Dr Gordon and Dr Jack wish to speak?

(*Dr Gordon*) My Lord Chairman, perhaps I might just follow on on two points from Lord Dixon-Smith's question and Dr Ogilvie's answer. We do have data in one area, and I am referring now to the funding of project grants rather than the funding of individuals as fellows. When a project grant is assessed we take care to distinguish between an applicant who has applied to the Trust before, an applicant who has never applied to the Trust before and an applicant who is applying to the Trust within the first two or three years of their lectureship. New lecturers, newly appointed academic staff, do better than average, they have a higher awarding rate for their grants. Individuals who have never applied to the Trust before have a worse chance of getting their funding, their award rate is lower, and the implication of this (although it is difficult to verify) is that these are very often individuals who have been in an established post for many years working without any external funding and in response to pressure, normally from the vice-chancellor or dean of their faculty or whatever, they have been prodded into attempting to get external funding and are not succeeding in the competition. I might follow this with just one other point if I may, my Lord Chairman, in relation to the new universities. In those new universities academic staff often have very substantial teaching duties and that may be inhibitory for them in getting their research started,

[Chairman *contd.*]

and through the initiative of one of my colleagues in the Trust, the Trust does have a scheme that will help newly appointed lecturers in the new universities to keep their research running, often in collaboration with the laboratory from which they came. They may have come from a university which has more slack. There is targeted money towards these individuals. This has been running for only a short time, but it seems to be very successful.

(*Dr Jack*) My Lord Chairman, Dr Gordon has covered the point that I wanted to make, which is the direct answer to Lord Dixon-Smith, that we do have a scheme that we set up deliberately to assist newly appointed lecturers in new universities.

Lord Phillips of Ellesmere

258. My Lord Chairman, perhaps I may ask one question here. Am I right in assuming that only established academic staff can apply for your project grants?

(*Dr Gordon*) It is a complex issue, my Lord Chairman, that would take me perhaps far longer than we have to explain in detail. In general the applicant for a project grant must hold an established post. The exceptions are easier to deal with than the cases at the margin. The Trust does not consider an application, say, from an established member of Medical Research Council staff; they have their own body to which they can go. Nor do we welcome applications from university staff members whose salary funding comes from a cancer charity; they can go to their own cancer charity. But members of staff in universities with medium term posts funded perhaps by another charity in some circumstances may well be eligible to come to the Trust. It is a complex issue that I would not want to go into in great detail.

Lord Howie of Troon

259. I have a more general question about funding that I should like to ask, my Lord Chairman. On page 5 of your submission you say that the trust provides a realistic level of funding and that seems to be ten times the amount paid by most of the research councils. Does that mean that the research council grants are unrealistic?

(*Dr Gordon*) My Lord Chairman, I believe that it is true to say that the normal level of the research training support grant coming with a research council studentship studying for a PhD has been increased recently from £400 a year to £600. If my memory of that information is correct, £600 is a very modest amount indeed actually to pay for the expenses of modern research whether in the biological subjects that are the trust's main concern or in some of the physical sciences, in some areas of which we do have some experience. A single research worker using modern molecular biological techniques might easily use £10,000 worth of materials and consumables a year and therefore an under-funded studentship can be a strain on the laboratory.

260. So that it is unrealistic?

(*Dr Gordon*) Yes, my Lord Chairman.

261. It is not a matter of you being lavish?

(*Dr Ogilvie*) In the field in which we operate we would consider £600 unrealistic.

Lord Phillips of Ellesmere

262. Perhaps I may intervene here, my Lord Chairman, to say that this is of course another complicated issue because the support of graduate students was not supposed to come entirely from the research training support grant but from the research funding of the funding council?

(*Dr Jack*) Yes.

263. There has recently been a study of this issue which was begun under the auspices of the ABRC and it has led to a discussion paper issued by the Office of Science and Technology and I think the Department of Education on how the funding of graduate students ought now to be arranged—how it should be partitioned between the funding council and the research councils. I absolutely accept your point that the funding of graduate students is a difficult issue and that a graduate student in your field costs a great deal of money every year, but it is not all supposed to come from the research training support grant.

(*Dr Gordon*) Of course, my Lord Chairman, we know all the points that are being brought up and we accept them absolutely.

Chairman

264. I should like to get back to the problem of what is the fate of these people, are there going to be opportunities, which was the question that I asked you before? When will they come? What is your perception of that? What should be done about those who are going to have to stay on these grants or go off and do other things?

(*Dr Ogilvie*) May I start on that, my Lord Chairman. Research training takes five to eight years from the time of graduation, the period spent gaining the PhD degree is not the whole of the training process. Most of us in the business I think would accept that it is not till five to eight years that you really know whether somebody has that flair, knack or whatever it is to do research, so therefore it is a good thing initially in the career of a young scientist to move about, to train in various places. The nomadic lifestyle is really very necessary as part of that training so that they get different experience and they work for different people, so we feel quite content about that lifestyle until people reach the age of about 30. All our experience indicates that that is when people make up their minds whether or not they are going to stay in the system, so we are not so concerned about that. Certainly personally also I feel that we would not expect everybody to stay in the system, that would be quite unrealistic, and it would be a very good thing indeed to have people who are well trained scientists moving to other walks of life, whether it is teaching or business or political life I do not think it matters; it is an excellent thing. What we feel should happen is that people should be managed in a positive way, not allowed to drift along, and that is where we often enter into debate with the

[Chairman *contd.*]

universities. I think that many of the better managed universities have begun to grasp this nettle and to make a positive decision about all their staff, at this crucial time, round about the age of 30—it varies with the individual. We police our Prize Students in particular very carefully. We get them together, we talk to them and we feel quite strongly that it is a privilege to have a very bright young person in your laboratory. We sometimes feel that not everybody shares that perception. We do think that positive management should start at the PhD level and continue throughout somebody's career. That is the nature of the debate that we often have with the universities—are they managing their staff in a positive way rather than by accident?

265. Who is doing the managing, where does it lie, at the departmental level, the central university personnel level, a combination of the two? One has to bear in mind, of course, that the new arrangements within universities where departments are cost centres would look to be the natural focus because that is where the money is both gained and spent. What is your view?

(*Dr Jack*) I turn to my university colleague here, my Lord Chairman.

266. It is an unusual university, I think!

(*Dr Jack*) My Lord Chairman, perhaps not from a university which has such clear cost centres as yet.

267. Nor is it short of a bob or two, is it!

(*Dr Jack*) I think that it is going to be a problem for universities, my Lord Chairman—particularly big and successful universities which have a large number of contract research staff—to do this management, and we do not have a clear view, speaking from the trust point of view, about how a particular university should do it, as long as they have a system for doing it. We do not feel that we should particularly suggest that. But perhaps as well as trying to put pressure on the universities to move towards some clearer management of the people who have been contract research staff within that university for some time—that if you like is the stick—we do have a very clear carrot. One of the carrots that we have that is used quite a lot, but perhaps not as much as we would wish, is what we call a University Award system, in which we assist the university to make a proleptic appointment to established staff. In those cases, we pay the previous contract researcher's salary while he is a university lecturer, fully for the first three years, half for the fourth year, and a quarter of that for the fifth year. So we are offering universities a real financial opportunity to make slightly longer term planning in making these proleptic appointments. We would certainly take the view that it is a really important way of attempting to assist universities to come towards better management of their older contract research staff.

268. Is that embodied in any document of the Wellcome Trust?

(*Dr Jack*) Oh, indeed, my Lord Chairman, it is widely advertised.

269. May we have a copy?

(*Dr Jack*) Of course, my Lord Chairman.

270. I think that it is a very interesting notion.

(*Dr Ogilvie*) And may I add, my Lord Chairman, that we have had this scheme in existence for 20 years or more and some universities take great advantage of it; others do not.

271. Are there any other trusts, foundations or bodies which are following a similar course?

(*Dr Ogilvie*) Not that I am aware of, my Lord Chairman.

(*Dr Jack*) No.

Lord Craig of Radley

272. Perhaps related to this, my Lord Chairman, and going as it were to the earlier stage of interesting people, you say that the prospect of working on a number of short term contracts may discourage talented individuals from embarking on a scientific career. I wonder whether you have anything more that you would like to add to that particular line of thought? It is quite important.

(*Dr Ogilvie*) If I may start, my Lord Chairman, again this is something that it is very difficult to give you very hard evidence about. Apart from the fact that my colleagues involved in our science funding activities spend a great deal of time talking to people in universities, we did a small study arising from the problems that women have in staying in science. Our policy section undertook a questionnaire investigation of 140 undergraduates and postgraduates at Leeds and Cambridge in physics and biochemistry and asked what their perceptions were. It was well organised within the limits of that kind of study. The interesting thing was that both the men and the women but particularly the women commented that they did not think that the nature of the scientific lifestyle was compatible with, in their cases, family life. But the men were not far behind the women in this perception.

Baroness Platt of Writtle

273. My Lord Chairman, what strikes me is that there is this instability, but is it not an instability in every part of national life at the moment? Many of us when we went down from university thought that we would get a job which might in fact mean you moved two or three times and then you would settle into, in my case it would have been industry, and work there for the rest of your life, but that is no longer the case anywhere. Is this not something that every young person has to face up to rather as they say that in the United States the average change of job is eight times during a career? There are obviously stable careers that people go into, but possibly people do have to be more entrepreneurial in choosing what they are going to do?

(*Dr Jack*) Yes, my Lord Chairman, indeed, there has been a change in the attitude of people that is linked with that, and I think that in a way the Trust policy is also still firmly of that kind. As Lord Phillips raised earlier with respect to the units the Medical Research Council has very successfully supported, they do offer tenure after a certain period of time. We have chosen not to support tenure but simply to move more of our funding, particularly of the older

[Baroness Platt of Writtle *contd.*]

contract research workers, for longer and longer periods as they get older, which is roughly the kind of circumstance that you are suggesting should hold. Now one of our reasons for deciding not to go for tenure, and therefore not to go to units, is just simply the concern that as a trust without the kind of national responsibility that the research councils have, we do want to keep our money reasonably flexible so that we can respond to new needs.

Baroness Hilton of Eggardon

274. Perhaps I may just follow up on that question, my Lord Chairman, relating to that. Do you think that the quality of science is affected by people's feeling of insecurity and the need to continue to look for new funds and new jobs? That is the anxiety, the quality of research and long term commitment to particular lines of research?

(*Dr Jack*) Yes, it is, my Lord Chairman, and of course it is why we have this particular concern about reaching some agreement with the universities, so that one of the escape routes for people who have been supported, say, for five or perhaps ten years by the trust, might be the ability to move from being a contract researcher, to membership of the established university staff, or help to find other jobs elsewhere outside the university centre.

(*Dr Ogilvie*) My Lord Chairman, may I add that in America the contracts are getting shorter and shorter, and we have always felt that one of the advantages of Britain, very much smaller though our effort is, was that people had longer time horizons so that they could therefore take on more difficult projects. If you shorten the time span to three years or less, which is what is continually happening, then people are much more inclined to put up applications for projects that are safe and sure rather than something that requires more imagination and more thinking time. This is the key issue, that I think the changes generally are reducing the time for real thought. If you are going to be original you really do need protected time, and that is why we are very concerned in respect of our stars in particular, but not just them, to give them longer time.

(*Dr Jack*) My Lord Chairman, if I may just add to reinforce that, among the group of people that we do now fund on relatively longer term contracts are people who have come from overseas and who have made an active decision to come to this country—many north Americans now—and one of the major points that many of them offer now as grounds for coming—and perhaps they have never been to this country before—one of the attractions of coming here is that they can get secure funding for a longer period of time and they feel that that actually makes the possibility of them doing research with real innovation much more realistic.

Chairman

275. Before Lord Phillips comes in, and I know that he wants to put a question to you, you have touched on something that goes to one of our questions, which is where those who fail go to, and you are now introducing a new element and saying that your particular scheme is one which actually is attractive to people to come in from high quality scientific countries, if I can put it that way, to work in the biomedical field because of your grants?

(*Dr Jack*) Yes.

276. Is that something that you think is—

(*Dr Jack*) It is quite a common point that is made by people when we ask them why they have sought to get funding from us and move to this country.

277. Really?

(*Dr Jack*) Yes, my Lord Chairman.

Chairman: Well, that is very interesting.

Lord Phillips of Ellesmere

278. My Lord Chairman, may I say to begin with before I go on to my question how much I agree with the point that was made about the need somehow to promote long term research funding. But of course there is a countervailing pressure from the research assessment exercise which is looking for results every three or four years, so that you have that working against your scheme. However, the point I wanted to come to really was this: I was astonished, as I think other members of the Committee probably were, to hear from the Association of University Teachers that 46 per cent of this rather large pool of contract research workers are looking for permanent research jobs. Now there is no tradition really in universities of having a cadre of permanent research people, at least, not to any great extent. Medical Research Council units provide one opening. Institutes of various kinds produce another opening. But you are really not offering in the end permanent research jobs. In the counselling of your people—and I assume that you too are involved in counselling your people—is that made absolutely clear to them?

(*Dr Gordon*) My Lord Chairman, perhaps I may deal with that point, because I have to deal personally with the Trust's Senior Fellows and Principal Fellows. A Senior Fellow might be appointed in his or her early thirties for five years in the first instance, renewable, but in the long term not necessarily to be funded by the Trust unless they succeed in the Principal Fellowship competition. We know each of these people individually and we know what their plans are and we know where they are likely to be able to go. If somebody, for example, is coming up for renewal we discuss with them very frankly the prospect for success in the peer review system, what other alternatives are available to them and so on. Now it is not as difficult a task as it might sound because these people have been very carefully selected before they enter the Senior or Principal Fellowship scheme and we know that in the most longstanding of those schemes, the Senior Clinical Fellowship scheme, individuals who have been funded through that for five or ten years do very well in finding the next post whether it is an academic post, occasionally in industry, occasionally in the health service, often abroad; we know that they do very well. But, yes, we do actually talk to the individuals at that senior level very carefully and realistically about the future for them.

279. Often abroad, you say?

[Lord Phillips of Ellesmere *contd.*]

(*Dr Gordon*) Not infrequently abroad. The world of learning ebbs and flows internationally, and Dr Jack referred earlier on to the pleasure that the Trust has in supporting some very good research workers who have come from abroad or who have come back from abroad and who have decided that for the time being this is the best place to do their research, but when defining the Trust's remit, Sir Henry Wellcome asked us to support research, he did not say support the research in the United Kingdom, and part of doing the best research might be for someone to work here for five or ten years and then to move into an established post in the United States or Australia or wherever if that is the best place to do that work.

Lord Howie of Troon

280. Dr Gordon mentioned something called the Principal Fellowship competition, I think?

(*Dr Gordon*) Yes, indeed.

281. Is that a competition among a number of people for a number of posts or grants or is it a career hurdle or what is it?

(*Dr Gordon*) At each point—appointment to a senior fellowship, renewal or appointment to a Principal Fellowship—there is a competition in the sense that the application has to be peer reviewed and then survive an assessment by an expert committee. For it to be a competition we actually have to take the different applications and place them one against another. For example, each year perhaps we get 100 or 120 preliminary inquiries for a Senior Basic Biomedical Fellowship, and that is whittled down in a process which I hope is as fair as we can possibly make it to a total of perhaps eight new awards each year. The clinical scheme is similar but perhaps two thirds that scale. With regard to Principal Fellowship inquiries we do not have very clear data on the number of inquiries each year, but again that is a competition where perhaps 10 or 15 inquiries each year will come down to a maximum of four or five awards.

Chairman

282. I wonder whether I may just press you a little further on this. With your past experience and with what you have said about the necessity for counselling and the universities perhaps not fulfilling their proper task here, can you advise us as to what is the kind of age range in which you think critical career decisions should be made with guidance and help and full information by researchers who having taken a doctorate have then gone on? Is it early thirties?

(*Dr Gordon*) My Lord Chairman, I would agree absolutely with Dr Ogilvie's comment earlier on. There is a time around the early thirties where an individual has had their training, it is possible to see what they can do and it is possible to come to a view as to what the likely outcome is for that individual. The people who are best placed to make that assessment are those who are around the individual and who are working in the same field because different fields of science have different patterns of research.

283. That raises another very difficult point because if one thinks of the unutilised half of the population that is an age at which they are most seriously handicapped in many cases by child bearing.

(*Dr Gordon*) If I may as far as possible quote from the Trust's rubric, my Lord Chairman, of course, in every case due allowance is made for a career break whether for personal or family reasons or for some other cause. We are moving to a situation where every one of the Trust's advertisements about this or that fellowship scheme does not say, "You must apply by such-and-such an age" or "This is the guideline age"; we say it is likely to be a certain number of years after, say, completing the PhD with due allowance for any career break in that time—so it is working years, not years plus time away from work.

284. You have allowed therefore for the problem of re-entry after a career break, have you?

(*Dr Gordon*) Yes, my Lord Chairman.

285. How do you manage that?

(*Dr Gordon*) My Lord Chairman, I might pass this to Dr Ogilvie in a moment because I know that she has looked at it closely recently. We do have a new scheme of Re-entry Fellowships to help people get back into research after a career break. These provide not only the support for the research, but also support to bring back a person who has been away from science completely or sometimes nearly completely. It gives them help to get them back up to speed, because science moves along very rapidly. This is a new scheme. The Trust has supported relatively few of these career Re-entry Fellowships, but if you look at the general pattern of individuals funded by the Trust whether on an existing fellowship scheme or supported on project or programme grants there are a large number of people who come back in gradually. I have papers on my desk at the moment of someone wanting to appoint two individuals part time to one post to help both these individuals to get back into science. I think that Dr Ogilvie has looked at this more closely.

Lord Craig of Radley

286. My Lord Chairman, would all these people coming back or being considered for a Re-entry Fellowship be people well known to you because they had been earlier supported by you?

(*Dr Gordon*) Not necessarily, my Lord Chairman.

287. It is a wider field?

(*Dr Gordon*) It is a wider field, yes. It relates to the earlier question about the way in which people going into a career as graduates in science are having perhaps to live in the uncertain world that all young people live in. I am struck by the contrast between the science graduates and the medical graduates with whom I also deal. Medical graduates of course all lead a nomadic lifestyle, they work for six months at a time, their contracts are for a year, two years, and so on, but they do not enter that career with the same uncertainty that the graduate scientists have. They know that the situation is more in balance and they also have a more clear cut set of alternative routes

[Lord Craig of Radley *contd.*]

into clinical practice, into hospital work or whatever, and one of my perceptions is that the graduate scientists do not feel that the system is adequately in balance. There may be an awful lot of them in the immediate post doctoral phase and there is not the right balance of posts at the more experienced level to take up those post doctorals.

Chairman: Thank you very much.

Baroness Platt of Writtle

288. Just before we finish, my Lord Chairman, I wonder whether Dr Ogilvie could come in and also—this sounds such a good scheme on your page 6—could we be told whether you are unique and whether other people do it too?

(*Dr Ogilvie*) You are talking about the Re-entry Fellowships?

289. Yes?

(*Dr Ogilvie*) So far as we are aware it is unique but we ourselves have only had it for two years. But when I looked at the detailed structure of some of the research groups that we fund I found to my interest and surprise that there were a number of women—and I am going to talk now specifically about women—who had re-entered in different ways. I can think of one woman in one group who had been out of science for 12 years, had an excellent record up to then, took time off to have a family and she is now coming back and working initially as a technician in the group in order to get her skills up to date. So that is one way of coming in. Another individual in another group was somebody who came back into science after five years away with the support of a Trust post doctoral research fellowship, not a re-entry fellowship but one in our normal competition, and she now has an MRC five year fellowship. Thus women are taking advantage of the flexibility that we and others offer. I do not think that we are alone in being flexible. Certainly all our schemes can be held in a flexible way and, of course, it is primarily to the benefit of women, but not solely. We have always had this flexible arrangement throughout the time I have been at the Trust.

Lord Phillips of Ellesmere

290. My Lord Chairman, this is a peculiar point. I was very interested in Dr Gordon's comparison of science graduate students and clinical students. It is one area of national life where manpower planning still exists, clinical students.

(*Dr Gordon*) Yes, my Lord Chairman, although—

291. You are not advocating that some degree of manpower planning would be useful in the area that we are worrying about?

(*Dr Gordon*) No, manpower planning of course is a very difficult subject. We know what goes wrong in Stalinist economies.

Lord Phillips of Ellesmere: Yes, indeed.

Chairman: Be careful, I was once a member of the Committee on Manpower Planning! It was called manpower resources.

Lord Craig of Radley

292. Exceptions prove the rule.

(*Dr Gordon*) There are factors other than just the careful planning of manpower numbers that operate in that system. The medical profession itself actually has learned to have some flexibility and it has to because it also has a large number of female graduates who take time out. Indeed, I would go a little further and say that in recent years, in terms of medical manpower, we have had instances where the planning of numbers in the training grades has been rather difficult for us supporting research—that is a question separate from those of direct concern to your Committee, but it is just to illustrate the difficulties I think you are alluding to.

Chairman

293. I should like to find a sentence which expresses in shorthand form the impression which you have given to me by these discussions and see whether you approve. My impression of what you have said is that while we are faced with a situation in which the established staff of universities have not grown in science while we have seen that at the same time a very large number of these contract research staff grow, they are not well managed, but even in a static condition as far as resources are concerned you believe that there are ways of managing them a very great deal better and getting through the next ten years until more of the established posts in universities become free and we have a more rapid flow again and a system steady state with more rapid flows in and out. Is that right broadly speaking and therefore, if it is right, would you say that the thrust of our comments should be towards directing the universities to do what you have told us some universities are already doing, which is to study this question more carefully and have systems in place which can both improve the quality of the research which is done and minimise the number of very short term appointments which you regard as relatively unproductive to good research and manage their personnel better?

(*Dr Ogilvie*) My Lord Chairman, I would say that that is very fair. But may I add to that that one of the problems that we have with scientists is that they do not believe that there is any life beyond bench work.

294. I am sorry, they do not—?

(*Dr Ogilvie*) They do not believe that there is any other way of earning a living as a bench scientist, so that one of the ways of handling them is to persuade them that there are other ways of spending one's career—they might even go and work for the Wellcome Trust, for example!—and I think that this is a rather narrow perception which needs to be modified in various ways.

295. Could one add to that what has been hinted at already, that is, that perhaps universities have a responsibility to try to help people to get more transferable skills so that they can meet what you seem to foresee by agreement with what Baroness Platt was saying, that life was going to be more varied in the jobs that they take from time to time?

(*Dr Jack*) My Lord Chairman, in that respect—

[Chairman *contd.*]

296. Well, do you disagree or agree?

(*Dr Jack*) I would agree with that, my Lord Chairman, and I would just like to supplement in a couple of ways. The first is that the trust when funding its full time researchers certainly does not discourage them and actively encourages them to participate in some teaching within the university system so that we do not expect them to be dedicated full time researchers. We think that actually it is part of their possible preparation for a transfer to an established university post that they should get teaching experience. The other point I should like to come to, to go back to something that Lord Phillips remarked on earlier, is that I do not think that it would be any surprise to us to hear that a lot of contract researchers would like to stay on as contract researchers but just have more security of tenure. The problem here is that often they are unrealistic and actually are seeking to have a life which despite the shortness of the contract that they are on is much more enjoyable for them than, for instance, being an established member of the university staff. It is a common observation made by both the contract researchers and even the doctoral students that we fund and that we talk to that they say that if they do want to stay on they would prefer to be researchers because they see the kind of range of pressures and demands made on established university staff as potentially a less enjoyable career. But it is certainly nevertheless a career that allows the continuation of research.

(*Dr Ogilvie*) My Lord Chairman, may I add something to what Lord Phillips raised? We are told now by some people in universities that when they are appointing new professors and they wish to appoint a real high flyer in research, these may say that they will only come if they have a contract that guarantees that they can spend most of their time on research, so the boot is almost on the other foot. Therefore, there is great pressure on the universities from the real high flyers in research to protect their time for research if they become a member of the staff; and by the same token the very, very high flyers often do not want to become university staff, as Lord Phillips said. They feel sufficiently self confident to survive by taking posts that have to be renewed at intervals, so there is a pressure coming back on the universities in unexpected ways. Chairman: I think that one can understand that pressure.

Lord Craig of Radley: My Lord Chairman, there is one other line of thought that I should like to follow, if I may, and it may be that I have it wrong. As I understand it, there are quite a considerable number of senior long term people who will come to retirement age making more jobs available on the permanent side. We also have a situation in which there are many more younger research scientists coming in than previously. If we bear those two facts in mind, is the opportunity which an individual will have to get a long term appointment actually going to increase in percentage terms as the years go by compared with the present situation? In other words, what I am saying, my Lord Chairman, is, are more people searching after a greater number of jobs but the percentage chance of an individual getting a long term job may be no greater than it is today?

Chairman: In fact, if there is a long residence time, to use a chemical kinetic analogy, then the flow of people must diminish.

Lord Craig of Radley

297. And are we actually confusing ourselves—maybe I am confusing myself, my Lord Chairman—in believing that there will be more opportunities for an individual in the future when in fact he is going to have to compete with more people?

(*Dr Ogilvie*) I think that it is very difficult to answer that question, my Lord Chairman, because we are dealing with an international market. It was not just Britain in the 1960s that had a huge expansion in academia, the generation that is coming up to retirement now, but the United States and I believe most of the English speaking world did too. I believe that in the United States there is going to be an enormous number of posts becoming vacant. Therefore, to answer the question you have to look at the whole scene internationally, and I do not have the figures to do that so I cannot give you the answer.

Lord Craig of Radley: No, but that is a very valid point, and I thank you for it, that one should look at it internationally and not just nationally.

Chairman: That is the position. We already know that the National Academy of Sciences and also the American Philosophical Society are concerned about exactly the same problem there that we have here; and you yourself, I think, have said that some contracts over there are even shorter term.

Lord Howie of Troon

298. My Lord Chairman, I have one very small question. You say the ninety-two principal and senior fellowships are from five to ten years' duration. Do you have any that are more than ten years, and what is the longest serving old stager, if I might put it that way?

(*Dr Gordon*) My Lord Chairman, the top, the most prestigious, of the Trust awards, Principal Fellowship, will guarantee funding for an individual for up to ten years, and then that can be renewed. There is nobody who has had a guarantee for longer than ten years from the Trust although some individuals have been funded and survived in the renewal competition. Individuals currently supported on the Principal Research Fellowship scheme include a few people who are within five to ten years of the normal retirement age.

299. Would you have anybody who has had a grant for more than ten years?

(*Dr Ogilvie*) I can think of one individual, my Lord Chairman, whom in fact we supported throughout his career on an annual basis!

Chairman

300. Shows a degree of indecision on your part!

(*Dr Ogilvie*) He worked in Brazil actually for all his career and eventually became a Fellow of the Royal Society, but he was a very unusual individual anyway. May I just add to that that almost without

[Chairman *contd.*]

exception I would say the people who win our Principal Research fellowships and most of our Senior Research Fellows actually have an agreement with their universities that if we do not fund them their university will support them.

(*Dr Gordon*) In many cases.

(*Dr Ogilvie*) In many cases, yes. They are very, very high quality individuals who have won in some very savage competitions.

301. I should not like this occasion to pass without hearing you speak as you have already written somewhat astringently about the Master of Research degree, and in particular my own interest would be to see what lies behind your statement that "the Government has overturned attempts by the Medical Research Council and the Biotechnology and Biological Sciences Research Council to set up four-year PhD training courses in the biomedical sciences", and then you go on to say that you have had some experience of this at the University of Liverpool. Now this is an issue which we are looking at actively. Some people are keen on the Master of Research; in some subjects they are quite the reverse. What have you to tell us?

(*Dr Jack*) Our general position, my Lord Chairman, is that we see great advantages in having diversity in research training and perhaps the phrasing is a little astringent about the Master of Research as one possible route in which this may be done. The reason for the astringency I think is the fear that a Master of Research degree of one year might be regarded in some way as an adequate form of research training for biomedical sciences. We certainly take the view that adequate training in our field, the field in which we fund, does require a longer period of time. But, of course, whether it is a Master of Research and then a three year doctorate, or whether it is a four year doctorate, might seem on the face of it to be just an issue of semantics. We are not clear that it is because the Master of Research, as least as we understand it, is expected to have a substantial component of research (probably of the order of 60 per cent or more). Our view is that for some areas of biomedical science, there may be required, if you are going to allocate a total of four years for that research training until you reach the post doctoral phase, a substantial amount more in-course elements as well as research experience, and that might be better folded into more than one year. That is the reason why we initiated this experiment in Liverpool in which there is a four year doctorate, and we have recently decided that we are actually going to go ahead and advertise some more opportunities for other universities to come in and make bids for four year doctoral programmes. Although we have got some guidelines as to how they might do that, we are going to leave individual universities to make their specific form of bid in the way that they think best suits their local scenes.

302. But within a four year span?

(*Dr Jack*) Yes, my Lord Chairman, a four year span, so I suppose that basically the Trust's position is that we think that it is coming to the stage, because of the depression in first standards of people when leaving school and hence in standards that they reach at the level of a three year undergraduate—

303. Can I just stop you at that point? It has always seemed to me that if a subject is really advancing in science oddly enough what you say about it gets less and less, not more and more, because the nature of science is that a new theory replaces old theories because it encompasses more information and makes it understandable. Why do we have to assume that courses must be longer and people are less well prepared at the end of it?

(*Dr Jack*) In many areas of biomedical science, my Lord Chairman, it is simply the diversity of skills that may be required to attack a problem.

304. Are you speaking purely now of the research element?

(*Dr Jack*) Yes, I am sorry, at the point at which—

305. I thought you were saying that the people at the end of their first degree were ill-fitted to go on to research and therefore this was necessary.

(*Dr Jack*) The standard at which they are taught is such that they may not at that stage be fully equipped.

306. Standard means content in this, does it?

(*Dr Jack*) My Lord Chairman, yes.

307. I see. I had taken it as something different.

(*Dr Jack*) So that if one accepts that slight drift in standards downwards, then a four year doctoral programme given the much wider range of expertises that may now be required to attack a biomedical problem, means that we think that a four year course to complete a doctorate is, or can be, beneficial. Not that it necessarily is the only route, but that it could be for some circumstances beneficial. With respect to the particular course that we have already had running at Liverpool, Dr Gordon has recently been there and had a preliminary look at it, my Lord Chairman, so perhaps I could pass that over to him.

(*Dr Gordon*) My Lord Chairman, I only looked at it a little and one of my colleagues looked at it much more closely. The interesting feature there—

308. Could you just tell us the subject, is it tropical medicine?

(*Dr Gordon*) My Lord Chairman, no, this is a course based in the Department of Physiology in Liverpool which, as I am sure you are aware, is an extremely strong department with a number of very good research groups, and the proposal that they made, accepted by the trust, was that if they had a grant for five four year studentships each year there would be an opportunity for more in-depth research training and there would be the opportunity for the students to look more closely at possible projects, to rotate between laboratories and actually to settle into a project that, on mature reflection, was more suited to their own abilities and interests. The first year of students is now in place and there are a number of features that have come out immediately. The first is that it is extremely popular. The demand for places in response to advertisement is very high indeed, 130 or 140 applicants each year.

309. From universities other than Liverpool?

(*Dr Gordon*) Yes, indeed, my Lord Chairman, for five places. The second feature is that students who enter the course welcome the opportunity to try out work in different laboratories and are going towards

[Chairman *contd.*]

one of the ideals that we would like to have in all cases in PhD training where the student himself or herself, on the basis of their experience, is actually able to set the project themselves and sometimes to come up with novel ideas of working between two different laboratories on a problem that those two approaches will illuminate. So it is very early days, my Lord Chairman, but the response from the students and from the course organisers is very positive, and I think that this is one of the features that led towards the governors agreeing to extend it to some other centres.

310. In what way would it differ from one of the old style mastership courses and then followed by a normal PhD? Is it in the range of choice of moving round between groups?

(*Dr Gordon*) I think it is in part in that and it is in part also in the factor that Dr Jack has alluded to, that there is not the requirement for any taught elements or gaining particular skills to be all confined within that first year; it can work organically through the four years of the course.

311. So that your general approach to the Master of Research is that there can be derived schemes over four years which would mean that the person coming through that will be better placed from your point of view than any of the existing schemes?

(*Dr Jack*) Yes, my Lord Chairman, we suspect that the university staff who are going to have to participate in one or other of these kinds of schemes, if we accept the total of four years, be it an MRes and a PhD or a four year doctorate, are likely to find that the four year doctoral scheme is more attractive simply on the grounds that they know when they select the students to come in—providing that they pass the internal university hurdles at an earlier stage—that they are going to have an opportunity for those people to continue on in their research laboratory. To run an MRes course, for example, without any of those people staying on, because perhaps they may go off elsewhere, is actually quite a heavy commitment in teaching time and in time in the laboratory where a great deal of it could be spent in simply training them in techniques; and, of course, one element of the pleasure of having a doctoral student in your laboratory is that once they are trained they are then productive and make exciting contributors to the research that is going on in the group.

Lord Phillips of Ellesmere

312. My Lord Chairman, most of the discussion I think has been about high flyers, as you call them, potential research leaders, yet a very large proportion of the contract research staff that we are concerned with in this inquiry are at a rather lower level than that; they are not going to be research leaders ever, they are in many ways rather advanced technicians or potentially rather advanced technicians. What do you have to say about that particular body of people?

(*Dr Gordon*) My Lord Chairman, that is of course absolutely true. An army does not consist of just generals—it is an awful army if it does. We recognise that every time the trust supports someone at a senior level as Senior Fellow or Principal Fellow that implies also support for that fellow's research programme, and that may include anything from two or three support staff to perhaps nine, ten or even more, and each one of the individuals who form part of that support staff has his or her own career. We would be concerned if no one had taken thought as to where they came from and where they might go. It is true to say, I think, my Lord Chairman, that an important feature in looking at the track record and proposals of any senior researcher coming in for one of these fellowship awards is how they actually handle the careers of their younger people. A person who ruthlessly exploited their PhD students and their post doctoral scientists and then did not have the strength of character to explain to a young person of 30 or 32 that really they had no long term future in science would be someone who would, I think, be much less likely to be funded themselves. It is part of running your research team that you actually look at where the members of that team come from and where they are going.

313. So that is part of your career counselling in a way?

(*Dr Gordon*) Yes, my Lord Chairman, I think it is part of that and it is part of the assessment of the individual. As I mentioned earlier, I know each one of the Trust's Senior Fellows and Principal Fellows individually and I am very struck by the care with which these individuals think about even quite junior members of the team—for example, they ask is it really appropriate for this person, I have recommended this one to move on, I think this person should stay, this person should come in for a Senior Fellowship in his own right—that kind of issue is always in their mind.

314. Are these people necessarily young? There are advanced technologies in biomedical research nowadays that require skill and a degree of experience so that one knows of quite senior scientists in this role?

(*Dr Gordon*) Yes, they are not necessarily young, my Lord Chairman. A Principal Fellow who is 45 or 50 years old himself or herself might well have an important right hand man who was of comparable age and who had taken a positive decision to hitch his star to the principal investigator and for them to go through together, we hope to retirement.

315. And you would support both of them?

(*Dr Gordon*) If it were appropriate for the individual, yes.

Lord Craig of Radley

316. I have one small point, my Lord Chairman. On the question of the nomadic lifestyle I am not quite clear whether your Trust helps with removal expenses and relocation expenses if an individual has applied from one location for an appointment in another or whether it is down to the individual concerned?

(*Dr Ogilvie*) We do provide up to £1,000 per fellow for removal expenses, my Lord Chairman, but I regret to say that there is at least one university that refuses to award this.

Chairman

317. I will just raise one point and then I think that we ought to conclude. You have spoken with praise of the four year scheme. You said that the Government has overturned attempts by the Medical Research Council and the Biotechnology and Biological Sciences Research Council to set up four year courses. Were those courses similar to your scheme and therefore did you approve of them as sufficiently similar? How did the Government come to overturn them? These are matters for the research council themselves, are they not?

(*Dr Jack*) My Lord Chairman, both those two research councils advertised schemes and asked for universities to make submissions. I am certainly aware of the fact that to both of those research councils two different sectors of my university applied. Then at a very late stage when the four year doctoral scheme had been submitted to those research councils there was a letter I think from the Director General of the research councils saying that in fact these schemes were not to go ahead. This caused a great deal of demoralisation and upset in my university among those people who had spent a great deal of time preparing for these courses. We have not had access to those applications although recently when Dr Ogilvie and I met Sir Dai Rees, the chief executive of the Medical Research Council, when we told him that we were going to proceed to advertise for some four year doctoral schemes he did offer us the possibility of seeing the applications.

318. May I ask the question whether those schemes that you prepared were rather like the Liverpool scheme? Was there a lead in through techniques into research?

(*Dr Jack*) My Lord Chairman, I am familiar with only one of the two schemes, but certainly that had elements that were very similar to the Liverpool scheme except that in the first year there was a substantial amount more course work involved. But this was a scheme for neuroscience where people may have entered neuroscience from a variety of different undergraduate backgrounds and this was to make sure that everybody had the opportunity to learn a range of intellectual techniques, if you like, that can be helpful for proceeding and giving freedom to pursue a variety of different approaches to neuroscience research via a doctorate.

319. Is it your impression that if you had in fact said to these research councils, we would be prepared to give an MRes at the end of one year, you would then have got away with it? You see where the whole argument is going.

(*Dr Jack*) My Lord Chairman, presumably that is subject to negotiation between the universities and the research councils—I do not feel I could comment on that.

320. Well, we shall be seeing the research council. We have seen Sir John Cadogan, but we can ask him again about this if we need to. Now are there any questions that you would like to comment on that we have not raised with you which are in the paper or within your minds which you have not had the chance to speak about?

(*Dr Ogilvie*) My Lord Chairman, I should just like to thank you very much for this opportunity to talk about something that is very close to our hearts.

321. Thank you very much, Dr Ogilvie. Would Dr Jack and Dr Gordon like to add anything?

(*Dr Gordon*) My Lord Chairman, if there are any specific questions we should be very happy to supplement our written submissions with any matters that might come to us.

Chairman: We shall not hesitate to ask you. Thank you very much.

TUESDAY 21 FEBRUARY 1995

Present:

Craig of Radley, L.	Howie of Troon, L.
Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Dixon-Smith, L.	Renwick, L.
Haskel, L.	Redesdale, L.
Hilton of Eggardon, B.	Platt of Writtle, B.

Memorandum by the Natural Environment Research Council

Executive Summary

Problems associated with academic career structures include uncertainties arising from having to progress through a highly selective system essentially dependent on renewal of short term contracts, the lack of realistic permanent employment opportunities within present academic structures for a large proportion of current contract staff and the perceived lack of parity for contract staff within the university culture.

Research Councils, jointly with OST and the Royal Society, are developing a draft "compact" for discussion with the CVCP, on the management, longer-term opportunities and career progression of staff employed on grant monies. Within this context NERC is also formulating its own scheme to support greater long-term employment security for contract staff who have demonstrated research potential.

Advantages for HEIs of the current academic career structure are the inherent flexibility in terms of recruitment and portfolio management. A wider advantage is the potential stimulus for mobility between employment sectors.

Available destination data indicate that some 40 per cent of research assistants on NERC grants find employment in industry, commerce or the public sector and that 22 (65 per cent) of the NERC Fellows who have completed their Fellowships since 1989 have successfully transferred to permanent positions in HEIs, research laboratories and industrial consultancy.

In addition to continuing to encourage academic/industry collaboration through existing schemes, NERC will create new opportunities to encourage positive mobility of contract research staff by allowing extended periods of Fellowships to be held in end-user collaboration. Industrial collaboration in the pilot MRes programmes will also be encouraged.

There is evidence of increasing participation of women in environmental research careers. NERC policy is oriented to the implementation of specific enabling measures such as the provision of full maternity benefits, removal of age and mode of study restrictions including the encouragement of career break, part-time working, job sharing, and provision of childcare facilities rather than positive discrimination.

NERC expects to support five MRes courses with a total of 50 studentships under a pilot programme starting in October 1995. The worth of the scheme in improving the quality and breadth of postgraduate training and transferable skills and providing a competitive terminal award in its own right remains to be assessed.

The following sections respond in more detail to the specific questions posed by the Committee in their call for evidence.

Questions 1 and 2:

What are the problems and advantages of the current career structures of academic scientists in the UK and the growth in short-term contracts?

1. Data from the Universities Statistical Record (USR) indicates that HEI income from all research grants and contracts increased by over 500 per cent between 1979 and 1993. Whilst the number of fixed term appointment (FTA) posts in the UK grew from 8,000 to nearly 18,500 (with 30-40 per cent of the current FTA cohort being supported by Research Councils), the size of the permanent, open-ended appointment (OEA) academic community showed no such overall growth. Across the system as a whole, there are now about six FTAs for every 10 OEA academic staff, although the FTAs tend to be much more concentrated in particular disciplines. Recent studies by the Institute of Manpower Studies (IMS) predict a further 30 per cent growth in the FTA cohort over the next five/six years in the HEI sector due to the ageing academic profile and the predicted growth in undergraduate numbers. Approximately one-third of the FTA group (some 6,000 staff) will be seeking new research posts every year, but the turnover of OEA academic staff through retirement

(rather than moving to fill other academic vacancies) will release little more than this number of posts during the next 10 years.

2. The principal problems associated with current research career structures surround the uncertainties arising from having to progress through a high selective system which is essentially dependent on renewal of short, fixed term contracts.

(i) There is a relative lack of attraction of science as a career for the best and brightest undergraduates in terms of perceived status, security and financial returns.

(ii) The recent 1994 AUT Survey indicated that half of HEIs employ research staff on FTAs on the lowest research assistant grade for over six years; only some eight per cent of these staff held three year contracts and some 50 per cent up to two years appointments.

(iii) Variability between Funding Council rules related to periods of contract, age limits, salaries and merit payments, conditions of service including staff review and development schemes pensions, redundancy etc, exacerbate insecurity and uncertainty for FTA staff.

(iv) There is a strong feeling amongst FTAs that they are not accorded full parity and esteem within university culture. They feel that they are regarded as a "pair of hands" rather than as staff to be actively managed.

A problem for the OEA staff is the considerable time, effort and money expended in applying for research grants and in recruiting/training research staff who may leave before the contract is completed.

3. Some of the advantages which are argued for the continuance of the current career structure schemes for academic scientists are as follows.

(i) The FTA system retains an inherent and essential flexibility to recruit new staff possessing novel, innovative ideas, techniques and personal vitality. Turnover is essential to the dynamism and vitality of the research community.

(ii) The FTA system offers considerable flexibility for institutional research portfolio management in terms of changing departmental circumstances and broader institutional strategic considerations.

(iii) The FTA system facilitates the wider availability of a cadre of highly trained individuals for whom opportunities to contribute to the enhancement of UK R&D is augmented by, but not limited to, their experience within Higher Education. Technology transfer and research training might, for example, be considered to be only fully effective in terms of overall UK R&D competitiveness if the staff involved move between employment sectors. Thus a semi-permanent FTA contract research tier might be considered to have some merits for the national economy.

4. Against the problems cited in paragraph two above, it must be recognised, as evidenced by the IMS studies, that there is no simple relationship between conditions of service/salary and research motivation or morale. Of arguably equal importance are issues such as academic standing; the ability to conduct independent research; and a degree of control over work and the working environment.

5. The higher education (HE) system would have to expand significantly to create realistic permanent OEA employment opportunities for a large proportion of current FTAs or alternatively individual HEIs would need to create many more new long term, semi-permanent (rolling) research career posts. However, the number referred to in paragraph 1 above of FTAs seeking new employment each year provides a basic indication of why the creation of a new research career track within HE cannot, by itself, be more than a partial response to the problem. Even doubling OEA academic staff numbers would only absorb a fraction of the FTA job demand over the next decade. The traditional assumption of career transfers from FTA to OEA is therefore no longer tenable. It also becomes increasingly difficult for long term FTAs to move across to other employment sectors from HE as they are viewed as being over-qualified and lacking relevant workplace experience.

6. Even if such an expansion of semi-permanent posts in the HE sector were to occur, HE would be left with a new FTA system as liable then to stagnation and slow turnover as the present research career structure; but this situation would be no different from that presented by OEA academic staff. If HEIs were to increase the number of OEAs at academic equivalent grades, it seems entirely inconsistent with current HEI goals and mission directions that such posts should be designed to retain personnel employed exclusively in research. HEIs might gain greater value in the long-term by freeing-up research time amongst existing permanent OEA academic staff through creation of new teaching assistantships.

QUESTION 3:

How do you expect the situation to change in the next decade?

7. One factor of importance is that the employment security of long-term FTAs is now converging with that of permanent OEA academic staff as the latter are increasingly losing tenure. This fact should provide an opportunity for the convergence of terms and conditions of employment within HE. The emergence of the recent UCL and Leeds University contract research staff Careers Schemes would indicate this is beginning

to happen. One can reasonably confidently expect this trend to continue so that in the long-term, the only substantial distinguishing feature might well be the source of funding.

8. The increasing emergence of Graduate Schools and importance of R&D income streams (including that derived from contract research) and their contribution to institutional/departmental infrastructure, mission directions etc, is forcing new attitudes towards FTAs. Delegated budgeting systems and internal income generation targets are requiring new mechanisms within HEIs for the support of both dedicated and interdisciplinary research. It is being increasingly recognised that "units of excellence" can provide an appropriate basis for longer term support for talented individuals and also serve as "cover" for interdisciplinary Graduate Schools. The latter can also be expected to play an increasingly important part in the development of research personnel policies within HEIs in the future.

9. All the Research Councils are reviewing their provision of and conditions for trained manpower in terms of the requirements contained in paragraph 7.26 of the White Paper on contract research staff. A joint-Research Council Working Group, together with the Office of Science and Technology (OST) and The Royal Society, has developed a draft "compact" for coordinated action by "funders" and "employers" to carry forward national strategic approaches for the improvement of long-term careers of contract staff. The "compact" focuses on the one hand on the provision of effective institutional policies to ensure and safeguard minimum standards for the management of staff employed by HEIs on grant monies in order to optimise effective manpower planning and career development. On the other hand, Research Councils for their part will look to provide longer term research opportunities and career progression. The joint draft "compact" proposal has been prepared and discussed and will now undergo some further revision before submission to the CVCP for their consideration and comment during Spring 1995. The objective is to reach a formal agreement between the "funder" and "employers" groups by Summer 1995 for implementation in the autumn of 1995. Successful implementation of the agreement would lead to radical changes in the structure of and opportunities for long-term, contract research staff in HE over the next decade.

10. As part of the above arrangements, NERC has established a Research Careers Working Party to formulate a structured scheme to support the long-term employment security of contract research staff who demonstrate the potential to successfully undertake scientific research careers. The recommendations of the Working Party will be placed before NERC Council in February 1995 with a view to implementing the new arrangements from October 1995. The end target of the new scheme will be to provide a clear and staged pathway for the support of long-term contract staff and to provide a better balance between contract research positions and the number of longer-term opportunities for talented scientists to work in university environmental science research.

QUESTION 4:

What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?

11. NERC does not hold information on the destination of contract scientists employed on its research grants but final grant reports would indicate that up to 40 per cent of NERC funded research assistants find employment in industry, commerce or the public sector. The OST is currently studying the feasibility of retrospectively tracking the careers of different postgraduate cohorts.

12. Of the 34 NERC Research Fellowships which have ended since 1989, 65 per cent of fellows have successfully transferred to permanent OEA positions. A further two per cent have moved overseas to permanent employment, two per cent are holding "honorary" university research fellowships and three per cent are on agreed extended fellowship arrangements. The destination of the remainder is still being traced. Of the 65 per cent who successfully achieved employment, the large majority have moved into "new blood" type lectureships, institute/agency research posts or into industrial consultancy. In overall terms therefore, it would appear that longer term NERC Fellowships are achieving their objective of continuing the initial FTA into a successful and early-mid research career pathway for prime movers.

QUESTION 5:

What should be done to improve the mobility of scientists between academia and industry

13. Transfer and mobility of people is by far the most effective means for exploiting the science base and securing the transfer of technology between HE and the industrial/commerce and other user sectors. There is certainly considerable room for improving the mobility and linkages between academia and industry especially with SMEs in the environmental science sectors of industry and commerce. Most of the existing schemes operated by Research Councils are based on individuals (CASE, Industrial CASE, Fellowships) or projects (LINK, CONNECT (a new NERC scheme to be launched in 1995), TCS etc).

14. Pilot postgraduate training partnerships with independent research organisations in private and public agencies provide optimum and highly visible means of developing bridges between academia and SMEs as

well as large firms and private/public research agencies. In this respect, there is room for the development of co-funded Fellowship and Career Development schemes bringing together Research Councils, Funding Agencies and industry.

15. New research career opportunities to be created by NERC in the near future will encourage positive mobility of FTAs by allowing extended periods of Fellowship tenure (up to two years out of five) to be held in industrial/commercial and other end-user collaboration. In addition, NERC intends to encourage industrial participation in the pilot MRes research training programmes (see response to Question 7).

QUESTION 6:

How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women and how?

16. NERC has long recognised that the proportion of women in science graded posts within its own Institutes declined with increasing seniority. Rather than taking separate and positive discriminatory steps, a number of enabling measures have been adopted including the encouragement of career break, part-time working, childcare schemes and job sharing. This flexible approach has led to a doubling of the proportion of women amongst those achieving merit promotion over the past four years (from seven per cent to 17 per cent at SSO and from 15 per cent to 29 per cent for HSO level). The same type and range of facilitating and continuing baseline approaches are appropriate for adoption in the university sector to encourage and advance research careers for women. NERC has, and will continue to adopt those enabling measures as part of its continued commitment to the principles and recommendations contained in "The Rising Tide". In statistical terms, some 37 per cent of PhD and MSc research students are currently awarded to women in comparison to a 26 per cent take-up level in 1989. Of the 14/15 Research Fellowships allocated annually, about a quarter (3/4) are regularly awarded to women scientists.

17. Specific enabling measures employed by NERC to encourage female participation in contract research careers include the following.

(i) Full maternity benefits—Research Students and Fellows are now entitled to maternity leave and pay on exactly the same basis as OEA staff ie up to four months full pay and in addition the award is placed in abeyance. FTA Research Assistants (and PDRAs) appointed on standard research grants also receive, via the university, maternity and related benefits on roughly the same basis as the local permanent OEA academic staff. NERC's understanding is that Research Councils currently reimburse these elements as part of the percentage addition (40 per cent) for indirect staff costs; such employer obligations being an automatic part of the indirect costs of receiving NERC awards.

(ii) Removal of age and mode of study restrictions—This enabling measure is intended to encourage applications from women scientists who have taken a career break for family or other reasons as well as those who are only able to pursue a research career on a part-time basis.

18. NERC's opinion is that there is evidence of an increasing participation of women taking up environmental science research careers and that the availability of a range of funding sources with flexible working arrangements and regulations may serve to better achieve the intended objectives of "The Rising Tide", rather than more narrowly focused mechanisms or separate positive discriminatory schemes. The key elements in NERC policy and practice are an assurance of equal opportunities and the elimination of practices linked to the short-term nature of FTA contracts which indirectly discriminate against women in science.

QUESTION 7:

The Government MRes degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.

19. NERC fully supports the fundamental principles underlying the MRes which stresses the continued need to improve the quality and breadth of postgraduate research training and transferable skills and in this respect the new free standing Masters is unreservedly welcomed. However, this objective can (and should) also be sustained through improvements and refinements of existing research Studentships (PhD, MSc) and NERC intends to seek evidence of the provision of such training and learning skills within normal quota and grant allocations. It remains to be seen whether the MRes will fulfil its further stated objective of providing an appropriate and competitive terminal award in its own right and achieve the equivalent recognition by employers of the vocational MSc programmes. There is a danger that HE might primarily view the MRes as simply an additional potential entry source and pre-qualification for the PhD rather than a genuine dual objective scheme also serving the diverse sectoral and generic needs of industrial employment. The worth of the MRes must be evaluated in terms of how far the outcomes successfully meet those twin objectives.

20. NERC received a total of 42 applications for its MRes research training pilot programme. Five courses have been provisionally approved for start up in October 1995 with a total of 50 studentships (10 per cent of

total NERC new awards) to be allocated. NERC will be working with other Research Councils to ensure cross-Council coordination especially in monitoring and evaluation of the pilot programmes.

January 1995

Examination of Witness

PROFESSOR JOHN KREBS, Chief Executive, Natural Environment Research Council, called in and examined.

Chairman

322. Good morning, Professor Krebs. Thank you for coming. Before we begin may I just draw your attention to one point which is at the top of page two of your memorandum. We had this problem with the Director General of the Research Councils and I would hate it to get general currency. The statement here is: "Data from the USR indicates that HEI income from all research grants and contracts increased by over 500 per cent between 1979 and 1993." This, I think, is a fair statement in cash terms but in real terms it is only an increase of about 150 to 170 per cent which then marries in quite well with the increase in numbers of these persons whom I think you call FTA, fixed term appointments.

(*Professor Krebs*) Yes.

323. Which increased, I think, by much the same percentage.

A. Yes.

324. I would hate it to become current that somehow the Government had provided resources which allowed a real expansion of 500 per cent when it is not true. Would you agree?

A. Yes. Thank you for pointing that out to me.

325. Next, thank you for your memorandum. You have got a list of questions in front of you. Perhaps you would like to make a general statement or highlight certain points in your report before we begin to tackle any questions which Members of this Committee would like to raise with you?

A. Thank you very much, my Lord Chairman. I think I will just be very brief in sketching my overall view. This is that the old concept of a career, something you get into at the age of 25 or 30 and stay in for life, until retirement at least at 65, is outmoded. I think we have to recognise that a career has been replaced by the concept of a series of jobs. So the task of those faced with supporting and managing careers in science is how to cope with the transition from the traditional career to the concept of a series of jobs. That is what I believe we need to debate and to understand.

326. May I just ask you, I think you make the point somewhere that this is true no less than these short-term appointments funded by the Research Councils but the removal of tenure from university posts means that that sector of employed persons in universities is in a similar position and that is the convergence is it?

A. I believe there is a convergence, yes.

327. I have been worried about this since I saw it in your report. This does make it rather difficult for universities to manage their total portfolio unless they have a degree of virement both ways. They already have the possibility of using their HEFC funds if they want to, not in salaries of course to support some of the short-term people but in resources. Looking back at my own days of running a university I should want to use the whole of the resources of the university to manage all sectors of it. Is this something that the Research Councils have thought through in their discussions with other bodies?

A. If I understand the question, you are really talking about infrastructure support for universities in terms of careers?

328. Yes, and also getting, for example, a balanced department. We might want to say that we want to top up on one side but the only means of financial resource which we have is from the other.

A. I think the full implications of that have not yet been followed through by the Research Councils. We clearly have to support research that meets our mission. That would be the boundary condition for the freedom we might offer to universities. I think co-funding between universities and Research Councils is an area that we are exploring and have initiatives in mind. I am not sure whether the other Research Councils are following the same line.

329. The reason I ask is because right from the beginning people have said to us why can universities not manage their resources like industry does which has to go out into the market and get some income year by year and then controls it all for its own purposes. The fact of the matter is it is not like that in the university sector, is it?

A. In the sense that often your customers who might be providing resources have specific objectives in mind.

330. Yes. Indeed you are responsible as an accounting officer to ensure that the money which you hand over to universities is spent only for the purposes for which it is awarded.

A. Precisely, yes.

331. I suspect that if, as you suggest, this situation is going to persist and not be relieved, as you say, by the temporary disappearance of the bulge of the aged staff and will recur then a good deal of thought has to be put into this, does it not?

A. Yes. Perhaps I could amplify on what sort of thought I think has to be put into it, in very broad terms.

332. Yes.

A. I think there are really four elements that are all interconnected. One is that one has to think of a career pyramid, that is recognising that the number of people you take in at the base is going to reduce as you go through to the top. There are always going to be more immediately post-doctoral scientists or immediately starting technicians than there are professors or senior technicians. This pyramid is the first concept. I think flowing from the pyramid one has to develop a proper exit policy. If you are losing people as you go up the pyramid you have got to have

[Chairman *contd.*]

a mechanism for doing that in a sensible way. The third element I would point to is handling a "sequence of jobs" as I call it, a sequence of fixed term appointments, implies a management process. This may be in the form of rolling contracts, or contracts renewable after a certain period of time, but that management process has to be clearly developed and clearly mapped out. It may involve collaboration, for example, between Research Councils and universities such as we see in many of the research-led North American universities. At MIT or at Harvard the university operates a shadow career for those who are on soft money. The individual may be getting his or her own salary on a series of contracts from NSF or NIH but the university accepts responsibility for providing the necessary back-up, perhaps commitment for continuity in the case of a gap in the grant or commitment to take on the person if the grant comes to an end, providing the back-up in the form of a shadow career. The fourth point, which really flows directly from my third point is that the universities as well as the Research Councils and other agencies that support staff in universities have to recognise that career development, appraisal, management, training, and if necessary retraining, is an essential component of a career that consists of a series of jobs. I would say that is in broad terms the kind of thinking that has to be undertaken. A lot of it, of course, has been undertaken and most of what I am saying is not by any means new, but we have got to be clear that we agree on the broad parameters and the mechanisms that are needed to implement the overall plan.

333. May I just ask one question before Lady Hilton comes in which touches on this pyramid. The Scots through their Higher Education Funding Council have reintroduced the old premature voluntary retirement scheme which would go some way towards doing this. Is that true in your view? Would that help?

A. I think any kind of exit policy would help. Obviously in later stages of the pyramid voluntary early retirement is part of the mechanism. If one is talking about a pyramid which starts with people at the age of 25 in the case of post-doctoral scientists, clearly voluntary early retirement is not appropriate at the early stages. The exit policy there has to be something that involves a sunset clause, notice that the termination of the contract is in view, and possibly retraining and so on.

Baroness Hilton of Eggardon

334. What worries me about the pyramid that you are describing is that it is an hierarchical management pyramid and it does not necessarily relate to science. You are talking about people progressing from being post-graduate scientists or becoming professors which implies managerial roles and so on. Surely in science this does not necessary apply? People can have, in terms of the hierarchy, a continuous flat career, if you like, but still be presumably competent scientists. They do not progress up the pyramid, do they? It does not seem that your model takes that into account.

A. That is a very good point. First of all I would say that I used the term post-doc-to-professor as a shorthand, not necessarily implying that it would be uniquely used as a management tool. However, I think you have raised the point that the career structure of scientists has to take into account at least four different classes of individual. There are the prime movers, those who are going to proceed from post-doc up to principal investigator and team leader, that is the group that I have been talking about so far. There is a second group who are what used to be called the experimental officers. They are not going to be those who become lead scientists and international stars but they are essential for running any research group. They may be skilled at programming computers or running sophisticated equipment or collecting and analysing data. There is a third group, which merges in with experimental officers, who are technicians, maybe maintaining cultures, in my research maintaining animals, maintaining field facilities. The fourth group, which we have referred to, are those who are going to leave, those who are exiting. You are quite right to point out that my previous comments referred primarily to the first category, those who are going to become prime movers, but we do need to have the mechanisms to deal with the other two categories that stay in the system, the technicians and experimental officers.

Lord Craig of Radley

335. Just to clarify in my mind one point at issue here which is talking about exits. You are talking about exits from academia and Research Council sponsored activities?

A. Yes.

336. Not necessarily from the science base as a whole?

A. If one exited from the university/Research Council/institutes or charity institute system, one might stay as a scientist in industry or in Government's service or one might be moving to a totally different career.

Lord Craig of Radley: Thank you.

Lord Howie of Troon

337. Thinking about this pyramid of yours, do you have an idealised pyramid in mind in your general forward looking? Is it an Egyptian pyramid or is it a Mayan pyramid or is it a pyramid at all?

A. We have been talking in NERC Council about a new scheme for career fellowships which would primarily address the first category of scientists that I talked about, the prime movers. In our discussions in NERC Council we have envisaged a pyramid, just for the sake of argument, as being one that within our portfolio we can afford, with a base of 40, move down to 20, to ten, to five. That is one answer to the shape of the pyramid. We recognise that our own pyramid that we have in mind has to be mapped on to the rest of the activity in the United Kingdom, so the pyramid that we have as an ideal concept may be much wider at the base, for example because there are other organisations that have short-term fellowships

[Lord Howie of Troon *contd.*]

to take people through from 25 to 30. It may have bulges in the middle if there are mid-career fellowships being added on through other mechanisms, and it may even end up with a bulge at the top in certain cases. I think one could have an ideal concept but one recognises in reality the pyramid may be made out of rather flexible material.

338. When you were deriving this idealised pyramid how did you go about it? Did you start off with the need for your 40, your 20 and so on, or did you work from the amount of money you had available?

A. Principally from the latter. We modelled financially how many people we think we could afford to carry through on a career to the age of 65 and what the implication of that would be for the numbers at each stage.

339. Is that really the right way to do it? Should you not start from the science end?

A. One wants to do a bit of both I think.

Chairman

340. Is there not a sense in which you need a broad base so as not to miss the good young people coming in?

A. It is clear you need a pyramid. I do not believe you could have an inverted triangle with more chiefs than indians. The exact shape of the pyramid is not something that we have been able—yet—to model closely in relation to the needs of the community.

Lord Howie of Troon

341. The shape of the pyramid is determined by money, not by scientific need, is that right?

A. I think in our case it is. It is going to prove difficult to determine the exact shape of what one would require from scientific need.

Baroness Platt of Writtle

342. Two questions, again on the pyramid. In industry the hierarchical pyramid is definitely being flattened with less lines of managerial supervision.

A. Yes.

343. Surely in a field like research where you have got very bright young people there would be potential for doing the same in academia? That is the first question. The second question is following on from Lord Craig's question. I was rather surprised that you did not seem to differentiate why people exited because you say in your paragraph 13 that: "The transfer and mobility of people is by far the most effective means for exploiting the science base and securing the transfer of technology...." That has been in a great deal of our evidence from other people, that you transfer technology on the hoof as it were. I would have thought it is frightfully important to know how many young people are going into industry because I would have thought that is desirable.

A. Let me take the first point. If I understood you correctly you were talking about the fact that progression in science does not necessarily follow a management structure. They may be bright young things who get to the top, so to speak, without going along the traditional route of lecturer, senior lecturer, reader, professor. I quite agree with that and I reiterate that I did use the terminology of post-doc and professor simply as a shorthand. The people who are getting to the top of the pyramid may be people who do not carry any traditional professorial administrative responsibility, they may be leaders of a research group or they may even be solo research scientists. So "professor" is used as a metaphor for being at the top of the pyramid rather than a literal description of management.

344. What I really meant to say was flattening the management structure.

A. As I say, my concept is divorced in a way from a management structure. I think one would still want to see a series of stages in what I called at the beginning a series of jobs. You start off as a PhD student, you go into some stage of post-doctoral fellowship which may last three, four, five years, then you move into a next stage which is an early to mid-career fellowship through to another one and another one after that. I was simply describing a series of jobs without necessarily implying management structure or flatness of the management organisation. Shall I come back on to the second point about where do people exit to? Clearly that is very important, to understand how people transfer from the science base into industry. We gave some figures, and I have got more detailed tables if you would like them, of the career destinations of our PhDs and our Masters. We have 250 or so vocational Masters' students that we support in universities. We can provide very good data on those. If we are looking at the more senior people we support who are Research Fellows, the bulk of those actually at the moment have stayed on in academia in open-ended appointments.

Chairman: I am sure we would be very glad to have any information you have on that.

Lord Dixon-Smith: I am becoming a little bit bothered, and I hope Professor Krebs will forgive me because it seems to me what he is describing is a system in which some people try to do other people's jobs. It seems to me that the Funding Councils—I am now going to over-simplify grossly—are in the business of being commercial clients of commercial organisations, in this instance the universities, to if you like provide various facilities which the Research Councils wish to have. What bothered me, particularly when you described your pyramid—I accept the image and I can understand that completely—was if you are not very careful you find yourself as a Research Council trying to tell the university, who is the contractor, how it should do its job. I accept in a sense it is all public money, or much of it is public money, and therefore there is, to a certain extent, bound to be a linkage and everybody has to find a way of working together but in the end it is the universities that actually employ these staff, it must be the universities' responsibility it seems to me both as to how they manage them and more importantly how they secure them. Whilst I can understand the Research Councils wanting to be concerned about this, and indeed being very

[Baroness Platt of Writtle *contd.*]

concerned about it because they need a feeling of security, they cannot actually do the universities' jobs for them although they might be able to exercise a certain amount of influence to persuade the universities to do things differently from the way they have been doing. It is a very delicate line that I am trying to draw.

Chairman

345. Could I draw your attention to paragraphs nine and ten of your memorandum and ask you, you should be having a council meeting, or have had, this month in which you will have had your working party recommendations. Will you be producing and publishing the results of your deliberations by, say, June? That is the first question. Secondly, in relation to paragraph nine when will the Joint Research Council Working Group with the OST and the Royal Society become public and when will discussions begin with the CVCP?

A. Thank you, my Lord Chairman. Should I answer your question first?

346. Yes.

A. The working group that NERC Council established on careers did report last week to our Council and the thrust of that initial report was the proposal to develop the career fellowship scheme that I have been describing. Council sent the working group away to do a little bit more work, particularly in fact touching on Lord Dixon-Smith's comment of whose job is it to manage these careers? We see the Research Councils as providing opportunities and universities as grasping those opportunities and managing them. We need some more work. The final report will come back to Council by the early part of June. It will be public knowledge after that. We would like to announce it publicly in June. The second question which refers to paragraph nine and our "compact", as it is referred to here, with the CVCP. We in the Research Council have now seen a revised draft of it. I understand that it is being shown to the CVCP within the next few weeks, in March. The deadline, as I understand it, for implementation and agreement for everybody signing up is in the autumn of this year.

347. Yes. I will not comment on the timing from our point of view but both the advantages and disadvantages of that will be apparent to you.

A. Yes. Shall I come back then to just touch on those questions of whether it is our job to manage? You are quite right, the universities as employers have to take primary responsibility for the management of people on Research Council contracts. The compact that we have just been talking about makes that clear. Nevertheless, there is a joint responsibility. We cannot simply hand over our funds to the universities and say "Get on with it", we want to monitor and be sure that our funds are being invested wisely in universities. We also, as I mentioned to the Lord Chairman at the beginning, want to be sure that whatever investment we make in universities supports our mission. I think we can provide opportunities, we can define the broad boundary conditions that we would encourage the universities to work towards, but the detailed mechanisms of management have to be the job of universities. I see it as a joint responsibility.

Lord Craig of Radley

348. Nevertheless, Professor Krebs, you talked earlier about your pyramid being built on a financial perception.

A. Yes.

349. Rather than a management perception.

A. Yes.

350. That suggests to me that if you were to have a pyramid that you have decided at various financial levels how many research scientists you should support, in other words you do provide to the universities a variety of levels of competence which is pyramid in shape. Would that be a fair understanding of your position?

A. Yes. We are providing opportunities to the universities, or to people who want to work in universities, to take up NERC Fellowships at different ages or stages. The stage pattern is basically pyramidal. The reason we want to do that is part of our mission is to support the core capability of excellence in research careers in the environmental sciences. Part of our contribution to that is by offering career opportunities to individuals who are deemed to be outstanding. They may work in universities, they may also, I should add, work in our institutes. The Fellowship Scheme will be open both to the universities and our institutes.

Lord Craig of Radley: The number of individuals who you would wish to support on a long-term basis, is that also arrived at by a financial perception or by a perception of the number of individuals who would meet those sorts of parameters of excellence?

Lord Dixon-Smith: Can I come in on a sort of supplementary to that. I am becoming confused again as to whether you are promoting research or whether you are promoting individuals. I think one needs to think quite carefully about that issue.

Chairman

351. Is it a choice because both are valuable commodities, are they not?

A. Absolutely, both at the same time. It is not a choice. Can I come back to the question which you will have to remind me the thrust of because I was distracted.

Lord Craig of Radley

352. The thrust of it was whether in supporting the science of excellence you are doing it on a per head basis or whether as a proportion of your financial resources?

A. We can clearly only support through this proposed fellowship scheme a very small proportion of the total of the number of scientists that the United Kingdom has or needs, a small contribution to the total activity. Others, through fellowship schemes such as that of the Royal Society, through standard university teaching/research projects will also be doing their bit.

Lord Phillips of Ellesmere

353. On the same subject, Professor Krebs, you have mentioned your institutes and the Committee will know that your Research Council does depend quite extensively on your own research institutes as well as on supporting research in the universities.

A. Yes.

354. In the management of your institutes you have clearly moved towards rather more short-term staff than you used to have. Could you give us an impression of the relative numbers of fixed term appointments whether in your institutes or in those that you support in universities? Secondly, what lessons would you draw from the institutes where it is exclusively your responsibility to manage these staff?

A. Thank you. The first question, what is the percentage of open-ended appointments in our institutes: we have roughly 75 per cent of our scientific staff on open-ended appointments, 25 per cent on fixed term appointments. When you look at it by age, of course, the picture is very different. The bulk of the open-ended appointments are people in the age range 35 to 60, the bulk of the FTAs are in the age range 25 to 35, so there is some history to that particular proportion. In the universities all the staff we support are external appointments. We have approximately 450 research assistants in universities, approximately 65 research fellows either on three or four five year appointments, 1,000 PhD students and about 250 MSc students. So as far as NERC is concerned all our support in universities is fixed term appointments.

355. And the number of fixed term appointments in your institutions, 25 per cent of staff, what exactly does that mean?

A. We have approximately 1,500 scientific staff in our institutions. It is a quarter of that.

356. So that is a not dissimilar number leaving aside graduate students?

A. Yes.

357. How do you arrange the falling off the pyramid system within your institutes?

A. With great difficulty I might say. As you are aware I have been in NERC for just under a year. I am pressing my institute directors to develop the kind of concept that the Council Working Group on Careers has been thinking about of a managed FTA portfolio. The tradition in the NERC institutes has been to move people rather rapidly from fixed term appointments on to open-ended contracts. The consequence of that is that NERC has in its institutes a large bulge of staff who are in the age ranges I have already mentioned, 35 to 60, the bulk of them 45 to 60, with the institutes having little flexibility, to terminate contracts should the people be no longer working in the way that they might have been expected to, or to move into new areas of science if new skills are required. At the moment we have little flexibility, I am trying to move the institute sector towards greater flexibility through the kind of career structure that I described earlier on.

358. You are slightly giving the impression that on the one hand you have to encourage universities into appropriate managerial practices in this system and on the other you have to encourage your own institutes into correct managerial practices. Do you not actually have more control over your institutes?

A. The institutes have extremely good career management practices in terms of appraisal, career development and inservice training for both FTAs and open-ended appointments. The universities, in my experience and looking at the statistics, on the whole treat research assistants on grants as pairs of hands and brains that come in and go out, they do not train them, they do not give them counselling in career development, they do not appraise them. We do have very good mechanisms in place in our institutes. What I am encouraging my institute directors to develop are mechanisms for greater flexibility in the future with regard to this large chunk of the population that are on open-ended appointments. I do have more control over it and there are also very strong constraints of history.

Lord Howie of Troon

359. In the middle of paragraph nine you mention "effective manpower planning". That has a ring of the 1960s about it, a period I quite enjoyed. It does have that ring. I thought we had got past effective manpower planning quite honestly. I am wondering, since you are not the only source of funds for research, some of it is private and so on, to what extent do you think your input can be effective in this respect?

A. What I meant by manpower planning there was really looking at the overall pattern of research/scientific teaching opportunities throughout a lifespan. It goes back to the issue of the pyramid, trying to understand how many people come in at the beginning and how many people are likely to stay in the system through until retirement, what is going to happen to people who do not stay in the system. It is not a *di rigiste* approach but it is simply modelling what the requirements might be. That is what I mean by manpower planning. With regard to us being one of a number of players, and perhaps not even a major player in the overall picture, I think the purpose of the bodies such as the Science and Engineering Base Co-ordinating Committee is to bring together the key players in the public sector, Funding Councils and Research Councils, to take an overall view of these issues. I think that would be one of the jobs of the SEBCC.

360. My recollection of the 1960s when manpower planning was quite in vogue is that it turned out to have an element of fantasy about it. Maybe you are too young to remember the 1960s.

A. I remember the Beatles.

Lord Howie of Troon: That is one black mark against you!

Chairman

361. I think I must intervene here because we have not yet focused our attention on the papers. There is one question which is of vital importance to us as we have been ranging over the general questions in front of us and that is this: you have referred again and again to the disappearance (you expect) of tenure on both sides of the divide, are you concerned or otherwise? Do you regard that kind of insecurity of

[Chairman *contd.*]

tenure as a stimulant to creativity or is it its enemy? This is a very important point it seems to me.

A. It can be both depending on how it is played. The negative picture would be the image of the person always looking over his or her shoulder for the next job. The positive picture is that the person on a series of short-term contracts sees those as opportunities for the future and is working towards the next stage. I think the issue of how it is perceived by those who are employed on short-term contracts is a matter not only for the individuals themselves but also the career managers. That is a job for the universities in partnership with the Research Councils and other organisations to take on board and to give the status and feeling of possibility for the future that will make people comfortable working on FTAs.

362. Should there also be portable pensions?

A. That will be a very important component. There are portable pensions to a degree but there should be complete portability.

Baroness Hilton of Eggardon

363. Can I just pursue that? It does seem to me that there is a slight semantic shift between those two visions of the effect of short-term contracts. In the first instance when you are referring to the individual who is worried about their next job you are talking about the subjective view of the individual but when you are talking about opportunities for the future you are in a sense talking about how it is perceived by those who employ the individuals rather than the individuals themselves. I really do not see how somebody on a short-term contract can be other than anxious about their future.

A. The answer to that is whether the default position on the short-term contract is that you do not continue your employment or whether the default position is whether you do continue it. If the assumption of the individual is that satisfactory performance in some way is clearly understood will lead to a continuation of the contract then I believe that it is a position that people can be comfortable with. I myself have worked on that kind of fixed term contract and had no difficulty with it because I understood that the assumption was that the post would continue subject to satisfactory performance.

364. The post can only continue if the money is forthcoming for another contract.

A. That is right. That is why you need, going back to the issue of career management and manpower management, to have some understood vision by all parties involved as to what the prospects are. This comes back to my pyramid. You have got to understand what your chances are of continuing through to the later stages of a career.

Lord Dixon-Smith

365. This is in a sense part of the dilemma, that the sector at large has been fortunate for the last 20 years or more and this has been a consistently expanding market. Has anybody sat down to think how they might manage the problem if it stopped expanding or, still worse, began to contract?

A. Do you want me to answer that?

Chairman

366. That is a statement, I think. If I could intervene at this point. We really have left quite a lot of things untouched so far and I am conscious of the fact that the EPSRC will be waiting now. May I just raise two issues? First of all, if you feel that we have not covered some of the questions here and they are not covered in your memorandum you are perfectly free to write in and give us any clarification that you feel you would like to give. Secondly, I would not like to miss the opportunity of any remarks off the cuff here, first of all about the position of women in science and secondly over the Master of Research degree. If you feel over the latter that you would rather withhold any comments until the pilot schemes have gone through that would be perfectly understandable but I noticed some quite clear views expressed in your written submission.

A. Thank you, Lord Chairman. I will be very brief on both. On the issue of women in science and its relationship to the FTA pattern that we have been discussing, an important concept is that people should be viewed in terms of their career stage rather than their age. If people have taken time out, women in particular have taken time out, let us say to have children, that should not be held against them because they are beyond the age limit for a fellowship. Any programme that NERC implements will be stage rather than age related.

367. Does that mean that a women who has taken, say, five or ten years out will, in terms of an age/wage relationship, fall behind her male counterparts?

A. Not in terms of age related career but in terms of assessment of the career stage that she is at.

368. Which means with corresponding financial disadvantage, does it?

A. Not necessarily, no.

369. Thank you.

A. But that does touch on the second point which I believe has not yet been fully addressed and I would wish to try and address in NERC is to have a specific programme for returners, those who take a long time out, maybe five years to have children, and need a short push to get back into the system. The third point I would make is from the surveys we have done in NERC a key element of structures that support women—child care, opportunities for part-time working and so on, structural issues—are very important in supporting women in scientific careers.

Baroness Platt of Writtle

370. Just a short question. When you talk about implementing a programme for returners, do you work with the Daphne Jackson Memorial Fund which has experience in that field?

A. Yes, we have had discussions with the Daphne Jackson Trust. They have a particular focus on offering a limited number of fellowships to returners. I have in mind a rather shorter term scheme where a

[Baroness Platt of Writtle *contd.*]

returner wishes to get up to speed in a particular technique or spend three months in the library catching up with the literature in order to be competitive in the environment that they are working in.

Lord Craig of Radley

371. So that programme for returners is very much a self-help arrangement but funded by a Research Council?

A. Yes. It is something that we have not yet got in place but I have in mind to develop something along those lines. I believe it is a niche that has not yet been fully recognised and the need is there. If I may continue very briefly on MRes. We have, as we have explained in our paper, implemented a pilot scheme in five universities. We are viewing it with a rather open mind although we have our initial thoughts and prejudices. We want to benchmark it against our MSc. We have, as I have already explained, quite a large programme in vocational MScs. We know that those students who come out with an MSc are very much in demand by industry, by Government and other employers. To give you one example, about 60 to 70 per cent of the MScs in geophysics in Edinburgh are snapped up by the oil industry; during the year they start courting these students to see if they can lure the best into their industry. That is one benchmark we will be using to compare the MRes with.

Chairman

372. Your evaluation, however, will be delayed by a year or two?

A. We need to have a period of experimentation. We will not really be able to comment fully for another couple of years. There is one more point I would make. It is clear that some of the universities to whom we have awarded the MRes studentship would view it primarily as a stepping stone to a PhD. That has come across very clearly, that they see most of their MRes students going on to do PhDs. They have agreed whether we are willing to guarantee continuity of funding, but of course that is not in the spirit of the OST's launch so we are not making any guarantees.

373. But when you say they are pressing on are they thinking of a further two or three years?

A. A further three years.

374. That means inevitably less research studentship, does it not?

A. Yes.

375. Just one final point. I picked up in paragraphs 14 and 15 that you are trying to develop new opportunities and new mechanisms for working with industry including five year fellowships, up to two years to be held with industrial, commercial and other end user collaborators. Are these at the stage where you would feel able to tell us about them and the co-funded appointments because I think this interface with industry is a very important one for the country?

A. I can provide you with some specific examples. The scheme as a whole is still in the embryonic stage but we already have some examples of co-funded fellowships.

Chairman: Could I ask my colleagues whether they would like to have that? It would be interesting. Are there any other questions that you would like to put to Professor Krebs? If not, thank you very much. I am sorry we have taken more of your time than might have been expected. We shall look forward to hearing from you.

Supplementary evidence from the Natural Environment Research Council

The NRA/NERC Fellowship scheme, to be introduced in October 1995, is specifically intended to support highly qualified manpower training in areas of mutual priority research interest. The scheme is seen as comprising one element of the partnership approach agreed in the concordat between NERC and NRA in terms of the development of joint actions. The co-funded arrangements will be targeted at basic and strategic level science to support training areas of both priority research and national need.

The initial agreement with NRA is to provide 50/50 support for up to a total of six Postdoctoral Fellowships at NERC Institutes/Units to be gradually phased in over the next three years and based on a two year tenure plus one further year option by agreement. The first Fellowship has been agreed in principle with IFE in Aquatic Weed Control under the supervision of Dr John Hilton and a second in either Fisheries Biology Management or Water Quality Modelling is being currently discussed with CEH.

First destination of NERC PhD students fifteen months after studentship ended

	Year of commencement	*1985*		*1986*		*1987*		*1988*		*1989*	
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
1	Permanent Academic Appointment	7	2	18	6	15	5	8	3	8	3
2	Fixed Term Academic Appointment	64	21	62	21	77	25	71	23	84	28
3	Further Training (exc Teacher Training)	2	1	6	2	8	3	4	1	8	3
4	School Teacher or Teacher Training	8	3	1	0	2	1	2	0	5	2
5	Private Sector Industry or Commerce	89	29	49	16	39	13	43	14	28	9
6	Government or other Public Sector	32	10	21	7	27	9	36	12	18	6
7	Other Employment	8	3	5	2	6	2	3	1	10	3
8	Not Employed	30	10	39*	13	29	9	38	13	29	10
9	Not Known by Institution	18	6	58	19	54	18	58	19	100	33
10	No Response from Institution	45	15	41	14	47	15	38	13	9	3
	Total	303	100	300	100	304	100	301	100	299	100
11	Overseas (included in above)†	33	13	17	7	27	9	24	8	31	10
12	Return Rate of Questionnaire		85%		86%		84%		87%		97%

*of which 27 writing their theses

†can be split into EEC and non-EEC

First destination of NERC MSc students fifteen months after studentship ended

	Year of Commencement	*1988*		*1989*		*1990*		*1991*	
		No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
1	Permanent Academic Appointment	0	0	1	0	6	2	5	2
2	Fixed Term Academic Appointment	22	9	3	1	10	4	18	7
3	Further Training (exc Teacher Training)	14	6	18	8	28	11	40	15
4	School Teacher or Teacher Training	0	0	7	3	0	0	3	1
5	Private Sector Industry or Commerce	95	40	68	29	81	33	105	38
6	Government or Other Public Sector	27	11	23	10	33	14	46	17
7	Other Employment	7	3	8	3	10	4	5	2
8	Not Employed	2	1	3	1	11	5	4	1
9	Not Known by Institution	23	9	65	27	56	23	46	17
10	No Response from Institution	49	21	42	18	9	4	0	0
	Total	239	100	238	100	244	100	272	100
11	Overseas (included in above)*	8	4	6	3	21	9	16	6
12	Return Rate of Questionnaire		79%		82%		96%		100%

*can be split into EEC and non-EEC

Memorandum by the Engineering and Physical Sciences Research Council

Thank you for your letter and for the request for comment in connection with the above enquiry. A response to each of the issues raised in your letter is given in the following paragraphs. Please let me know if we can help by sending further comment or by amplifying any of the statements made.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

The main problem remains that a large number of academic posts are filled by those brought into the system during the rapid expansion of the 1960s, when academic positions were reasonably easy to obtain (at least when compared with the extreme competition that presently applies to new appointments). Despite various "new blood" initiatives in the past decade, there has been a dearth of new talent entering faculty appointments in the past 20 years, and a distorted age profile has now resulted in many disciplines. (For example the "Roberts Review" of Physics in 1992 showed that the average age of faculty members in Physics was 48—with 50 per cent of the population aged over 50 and 25 per cent aged over 55). Although the concept of "tenure" no longer pertains, there has been (with a few notable exceptions) little turn-over of the "old guard". The few new academic appointments available in recent years have attracted candidates of exceptional ability.

The demise of the "binary line" between the traditional universities and the polytechnics has seen an increased range of activities now embraced within the general term "academic"; and the proliferation of academic titles such as Professor. The idea of a balanced academic working pattern, dividing time between scholarship, research, teaching (and not too great an academic burden) has long since passed. Increasingly academics are having to spend large amounts of time on administration—especially the bidding for funds from the Funding Councils (via the assessment exercises), the Research Councils, Europe, and elsewhere. While it is difficult to identify particular advantages from the present career structures, it needs to be said that the status of UK academics is still greatly admired in the international scene.

2. *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

The concept of maintaining a healthy turn-over of young researchers in academia on fixed-term contracts is basically sound. After serving a research apprenticeship during their PhD training, then taking a leading role in a post-doctoral project, it is appropriate for the majority of post-doctoral researchers on fixed term contracts to move on to industry or elsewhere. This is the most useful form of technology transfer ("on the hoof")—as young people move out of the hot-house of academia into the productive economy, with an appropriate number (the minority) staying in academia.

The difficulty has been with the strong growth of fixed-term research contracts during the 1980s (the number in science and engineering doubled from 9,000 to 18,000). This growth was unsustainable; and exceeded the capacity of the nation to absorb these talented young researchers either in academic faculty appointments or into the external work force. Many stayed in academia on repeated short-term contracts—becoming increasingly specialised (thus making eventual external placement more difficult); and increasingly frustrated as "permanent" academic appointments failed to materialise because of the paucity of positions presently available (ahead of the demographic precipice being reached over the next decade).

Many universities are now giving increased attention to developing a sensible career structure for contract research workers. We are particularly attracted by the schemes introduced at the University of Leeds and University College London. The Research Councils are working on "best practice" guidelines they would hope to see developed by institutions receiving research council support.

The universities have tended to make faculty appointments based on Funding Council income, which was deemed to be "hard" (longer term) than on "soft" Research Council income (typically three-year research grants). With the Funding Councils assessment exercises (on which research income is based) now being carried out every four years, the distinction between "soft" and "hard" income has become blurred. We would like to see universities moving to a career structure based on anticipated steady income (from what ever source)—and not automatically placing all those supported from Research Council funds on fixed-term contracts.

3. *How do you expect the situation to change in the next decade?*

The Funding Councils have, we know, been undertaking detailed demographic studies by academic subject. They should provide the detailed input here. However we are only too well aware of the problem which will arise between 2005 and 2010 as the "1960s bulge" finally works its way out of the system. While the pool of contract researchers will help fill the gap, there is a danger of thus creating another "bulge".

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

We undertook a study in 1993 of those whom we had supported on fixed-term fellowships. A copy is attached which shows where fellows were going (mainly into academia and industry).

Most of the people we support on fixed-term contracts are on research assistant positions, rather than fellowships. (We support some 200 fellows, but over 5,000 research assistants). We do not, I am afraid, keep data on the destination of research assistants.

5. *What should be done to improve the mobility of scientists between academia and industry?*

There is undoubtedly scope for an increase in the number of industrial fellowships to allow academics to spend time in industry—and vice versa. However the industrial fellowship scheme we run with the Royal Society has not proved particularly popular, and there is a need for education on the benefits of such exchanges.

We have looked at the possibility of offering a fourth year of support for post-doctoral research assistants working on collaborative research projects, to spend the fourth year in the collaborating company transferring the technology developed in the previous three years in academia.

The Teaching Company Scheme is an effective means of giving young graduates experience in industry.

6. *How do you expect the situation regarding women in SET to change in the next decade?*

This is essentially a "pipeline" problem, mapping back into the schools. Until there is an increased interest amongst girls in studying science at A-level, and thence at Univeristy, then the problem cannot be fully addressed.

There is still much that the funding councils and research councils can do in providing "positive discrimination" for re-entrants following career breaks, and so forth. The OST is co-ordinating such measures to be taken by the Research Councils.

7. *Please outline your assessment of the worth of the Research Masters scheme.*

The OST consultation exercise showed that there was little interest from the core science disciplines in the Research Masters concept (the four-year undergraduate option being preferred to embrace the elements envisaged for the Research Masters). However there had been strong interest in interdisciplinary areas (such as materials) and generic technologies (such as IT) which do not match well onto undergraduate teaching disciplines. We expect the Research Masters to prove of particular value in such fields; the majority of the 15 pilot programmes we are in the process of selecting are likely to be in generic technologies, engineering, and interdisciplinary topics.

We particularly welcome the "broadening" aspects envisaged for the Research Masters, and would like to see these built into the Doctorate programmes of those who have not taken the Research Masters ahead of a doctorate. Inevitably we feel there will be an increased requirement for a taught component in all doctoral training; in research methodologies, specialist knowledge, and transferable skills.

The real worth of the Research Masters can only be assessed following the forthcoming pilot. The interest from potential students will be evident early (in demand for places on Research Masters courses). The interest from potential employers will take longer to ascertain.

Professor Richard J Brook
Chief Executive.

9 January 1995

Examination of Witnesses

PROFESSOR RICHARD BROOK, Chief Executive, and DR A E HUGHES, Deputy Chief Executive, and Director, Engineering and Science, the Engineering and Physical Sciences Research Council, called in and examined.

Chairman

376. Good morning, Professor Brook and Dr Hughes. Thank you very much for coming to see us. Thank you also for the memorandum which you have put before us. May I ask you whether there is anything you would like to say yourself at this juncture by way of a lead into our discussions?

(*Professor Brook*) Very briefly, let me first of all thank you for the chance to be here. This is a topic which is seen as important within the Research Council arising in part from the fact that we do make provision for a large number of workers who are at a certain path along their academic careers. This starts with studentships where we have something of the order of 8,000 in place. We have fellowships which are for people quite specifically to get them launched on university careers; there are some hundreds of those. That passes through to the senior fellowships which are for people at quite an advanced stage in their research career. So the Council is there as an active participant in the theme which you are discussing but not perhaps as the controlling agency whose role lies more of course with the universities themselves as the employers and with the Funding Councils who are the ones perhaps more concerned with the form of university structure. Our role is to try and buy the best research we can for the finance which is placed at our disposal and to try and support the best research workers that we can find. We do that in a way which is directed at certain points along a well established research career.

377. Thank you very much indeed. One preliminary point: I found your memorandum very helpful, particularly the enquiry which was commissioned by you. I noticed in this there was a great deal of variability between subjects and the number of fellowships which were (a) held overseas but (b) it struck me as the first information we have had that in your range of subjects at any rate those who go overseas very largely come back. Is this a correct impression that I have got?

(*Professor Brook*) You are referring to people who are, say, completing a fellowship in mathematics, physics or chemistry and who then take up a university appointment in the United States or in the former Commonwealth, that sort of pattern?

378. Many of them come back to this country on these figures.

(*Professor Brook*) Indeed. I think the "brain drain" as it is so called passes in one direction sometimes and passes in another direction at other times. I think we can draw some solace from the fact that the flow in both directions seems to balance out. We do benefit, as we saw even yesterday in making appointments to

[Chairman *contd.*]

one of our fellowship schemes; there were applicants there who are out of the country at the moment and we have the opportunity to bring them back.

379. You also say somewhere that the international status of British scientists is very high. Does this mean that people are queuing up to come into the United Kingdom? Do we have a reverse "brain drain"?

(*Professor Brook*) I noticed that you had asked about this and, looking back at the text, I see that our wording is slightly unhappy for the degree of ambiguity which is there introduced. I think the answer to the question was really in the form that the *quality* of United Kingdom academics remains fully recognised in the international arena. In respect to *Status*: if you mean by that how are they respected by their fellow citizens then that becomes immediately anecdotal and it varies of course enormously for different parts of the system. The part we were talking about was the evidence we have, that is for visitors coming to the United Kingdom and wishing to work with United Kingdom groups in prosecuting their own research; here there is clear evidence of the viability and indeed high merit of British research. It is quality which is indicated.

380. By and large you are satisfied, are you, that of the money which is spent the major beneficiary in terms of countries is the United Kingdom from the returning numbers and those who stay here and do not go overseas at all?

(*Professor Brook*) That is a new thing which appeared in our mission as a consequence of the White Paper. I think it was the first time that the United Kingdom's competitiveness and quality of life was picked out as the specific target for our work. This has caused us perhaps to think carefully about supporting research where we believe that the real fruits from that research pass into other economies and have hardly any influence at all in our own. There are one or two examples like that. Nonetheless, I think for the most part that your statement is one I would agree with; it is an international community within which we work, a community of scholarship, and we see benefits flowing from both directions. So the quality of the work and the quality of the person are the key attributes that we look for in deciding where to give support.

381. We are mainly concentrating on the careers of these people by way of introduction. Are you concerned—you state you are certainly—about the problem of these short-term appointments following one upon another and the way that they are managed or mismanaged? If the latter, have you got ideas about how the situation can be rectified?

(*Professor Brook*) There was a concern over the number of post-doctoral workers, this is people who have completed their doctoral degree, who then decide to stay on in that university or maybe move to another university to continue on a short-term contract and then renew that contract and then renew that contract. We do not see that as being a correct pattern for the development of a research career. We saw it happening, and I think a note was made in the response that there was some doubling of the numbers. The view was that, at a time when it was difficult for graduates to find employment, either in the university sector or in the industrial sector, then there was a tendency to stay on in these temporary roles of course in the hope that the opportunities would become better. I think, as you will know, the feeling is that that can then be to the disadvantage of the person in the post, that they become ever more narrow in the specialisation which they follow and their chances of finding full employment later in a productive manner are reduced perhaps if they stay too long.

382. Is it that specialists are not seen as being capable of becoming generalists after a particular period?

(*Professor Brook*) Different people have different opinions. We have one a panel which we use to guide the Council in its policies, the so-called Technical Opportunities Panel, including a member of the mathematics profession who will not be unknown to you. The panel explored the belief that a mathematics doctorate can indeed be a narrowing experience.

Chairman: Lord Phillips. We will leave mathematics, shall we!

Lord Phillips of Ellesmere

383. Your predecessor body, Professor Brook, at one time, I do not know for how long, had a rather sledgehammer approach to the management of the short-term staff by saying that it would not support such a person for longer than six years altogether. That did not of course prevent them getting support from someone else. Do you still adopt that policy or is it the underlying theme of your policy?

(*Professor Brook*) The argument is the following: if we can be persuaded that universities have set procedures in place for guiding research workers in these shorter term contracts so that all parties can be persuaded it still adds up to a sensible career development then I do not think we would be opposed to it. It is not a categorical refusal of people beyond a point.

(*Dr Hughes*) Generally speaking, we are trying to change from what you have described as the sledgehammer approach, to one which recognises that the universities are the employers. What we do is actually pay for the people who do the research on grants that are awarded by the Research Councils. Our role is to try to encourage a mutually acceptable way of ensuring that proper career development activity takes place within the university, to cope with the rather varied nature of these short-term jobs. There is now something close to being in place which I think broadly does move it in the right direction.

Lord Phillips of Ellesmere: Thank you.

Chairman

384. Could I just ask a question which is in relation to a rather striking statement you made in Section 2 paragraph 2 of your statement, namely: "...the capacity of the nation to absorb these talented young researchers either in academic faculty appointments or into the external work force." Is that really

[Chairman *contd.*]

another way of saying you think there are too many of them? If so, wherein does the fault lie and what can be done about it?

(*Professor Brook*) I would prefer almost to debate from the facts that we have at our disposal. I have colleagues in the university sector who would say there are too many scientists.

385. Really.

(*Professor Brook*) I have other colleagues who would say that we need very many more. Therefore it is very much a subjective viewpoint and it is hard to come to some general conclusion. Our viewpoint here is that the number of workers was driven to a higher level than was appropriate by the fact that they could not find employment in the next step in their career; we strive for a smoothly functioning system with so many people passing through it each year who can then find posts. If a blockage occurs in that process they accumulate at a certain point and we believe we have evidence for that.

386. But that blockage will be relieved by the fact that the age profile of the staff is such that in the next ten years a lot of people will be retired.

(*Professor Brook*) I think there is the opportunity for the best from among this grouping to have a good chance to find academic posts when the so-called 60s group moves through. I think the argument then, and I think it is noted in a question in the brief here, is that it is important to make appointments of people at different stages in their careers so that you do not merely reproduce the problem 30 years later.

387. Or even sooner than that if you fill all the vacancies.

(*Professor Brook*) That is right.

Lord Howie of Troon

388. Surely to some extent this problem is out of your control because it depends, does it not, on the state of the economy?

(*Professor Brook*) Yes.

389. You are whistling into the wind in a way, are you not?

(*Professor Brook*) I would agree with you in saying that there are dangers that the Council believes it can take on a role of social engineering, I do not think it can do that. I would agree that we are as subject to the changes in the state of the economy as other aspects of national life. Our role, as I say, is really to ensure that the best of each generation in terms of research capability as they come through the system can find support from us and can find it at different levels in their careers so that at the point where they become first independent from a supervisor and move out as an independent research worker we have a scheme which is capable of dealing with it. Yesterday we allocated 20 awards which gave five years' independent research opportunity. The hope is that that group would find a place later in the academic or industrial professions.

390. One more question arising from paragraph two, in the last three lines of the paragraph you talk about a career structure which you would prefer. Are you suggesting here that rather than fixed term contracts you would like to see people employed in what used to be called a "steady job"?

(*Professor Brook*) What is being said here is that the Funding Councils have the reputation of providing I think what Americans call hard money, that is where the future sum of money is guaranteed, therefore they can make lifetime appointments. The Research Councils have the reputation of using soft money, that is to provide somebody to do a piece of work and then that post would be gone. That was a very clear distinction between the role of the Funding Council and the role of the Research Council. What is being argued here is that there may be advantage if the universities can soften that distinction and recognise that the Research Councils do offer short term posts for three years but we offer also the Interdisciplinary Research Centres, for example, which are ten year schemes. Therefore we have a variety of schemes of different durations. Correspondingly, the Funding Councils have become less predictable—I think the days of quinquennial planning have gone, for example—and therefore an uncertainty has come into Funding Council funds with sums being influenced by the Research Assessment Exercise and by Teaching Assessment. That very stark distinction between two types of support has eroded I think. The plea then is: will universities please use the full flexibility of both systems to try and build an internal environment which is encouraging to their staff and which provides them with career patterns.

391. You are expressing a preference here in the end of your paragraph. You did not quite answer my question. Are you expressing a non preference, shall I put it that way, for fixed term contracts and a preference for, as I describe them, steady jobs?

(*Dr Hughes*) Could I comment here. I think it is not as black and white as that. What we are saying is that, especially now that we are responsible for the support of more technicians working on projects as well as research workers, we would prefer not to be dealing with a situation where every person we support is automatically on a fixed term appointment related to that particular research project. There ought to be some way of melding that with the concept of longer term appointments, particularly for instance where technicians are concerned. One would expect the University department to be able to foresee that it could expect to have work going on in a certain area that would require a certain level of technical support. It just happens that at any given time some of those are supported through particular grants from us and at another time they may be supported from some other funding source.

Chairman

392. You referred specifically in one paragraph to the consolidation of the soft and the hard money so as better to be able to manage the careers of the staff from wherever the money comes.

(*Dr Hughes*) Yes.

393. Now, putting yourself in the place of a university which has to do this, is it possible only to do it if you have some fuzziness of the boundaries and are able to vire money between the two heads

[Chairman *contd.*]

which under our arrangements comes from two quite distinct bodies, one—as you said yourself—the Funding Council and on the other hand a Research Council? Would you be prepared to allow that? It is a problem which may not be considerable in a very large institution like Imperial College or University College but it could become more acute in smaller universities?

(*Dr Hughes*) I think there is a practical problem in managing a situation such as we are discussing. At present there are undoubtedly some difficulties in doing that in a fully flexible fashion but, on the other hand, we have recently moved to a method—which we call profiling—whereby the payments for our research grants are more controllable from the university's point of view, and from our point of view, and at least that does allow the university to make some adjustments which may vary with time throughout the lifetime of the grant. We are concerned about the total effort on the whole grant rather than necessarily what may be happening at any particular time.

394. Will this emerge in the course of the Research Councils discussion not only with the OST but later with the Vice Chancellor's Committee?

(*Dr Hughes*) It is an on-going subject of discussion, but with all of those bodies I think it would be—rather like the earlier question, Lord Dainton—incorrect to think of these things as very black and white and clear cut, and that there is an instant point at which everything changes. I think there are on-going moves towards what we all hope will be a more satisfactory system that universities can work with more comfortably and that we can work with within the constraints that we have.

395. Before I call Lord Phillips and Lord Redesdale I would just like to try and see if you would agree with the proposition which I would put to you that, first of all, the circumstances are never the same from decade to decade and what you are trying to do is really like a thermostat, adjust yourself to the changing circumstances? You will overshoot and undershoot, is that not so, and you want to keep the amplitude of these swings to a minimum if you can? It does require very flexible arrangements within universities, is that the position?

(*Professor Brook*) I think that is true. There is also a certain tendency within the Council for something to occur which has happened within the industrial sector namely to return to core business activity, if I put it that way. I think that the Research Council sees its role as acquiring for the nation the best research results and the best trained research staff that we can find. That is something where we would hope to collaborate with universities in the fullest way but I have a certain nervousness about going too much into their administration and interfering with it. I think that if we provide clear rules for how we plan to operate, and that if we are sympathetic in how we run those rules then I would hope that the university's system would find that the most constructive contributuion.

Lord Phillips of Ellesmere

396. I just wonder, my Lord Chairman, whether we do not have a tendency in the discussion to move back always to the most hardened people, to the best research staff and so on, whereas we know that 25 per cent of these people on short term appointments are actually in Research Assistant 1B grades, possibly doing PhDs themselves, and not necessarily destined for high level appointments either in academia or in industry. This comes back really to Dr Hughes' point about the flexibility that universities might have in foreseeing their need for technical staff and research assistant staff at that sort of level and funding it from different sources. I think there is a difference between looking at that level of staff and looking at the high flying staff which are destined for higher appointments. Would you agree with that?

(*Dr Hughes*) Yes, indeed. I think to some extent one might even go so far as to say that, given the various schemes there are, the truly high flying people in a sense will always do well. There may be temporary hiccups for their aspirations but they will come through in the end. That is not the case for the sort of cohort that you are referring to and it is certainly very much the case that probably the majority of people who become RAs of one sort or another will not actually find jobs in the academic sector in any permanent or semi-permanent sense. We do have to be concerned about that aspect of it all, very much so. There are I think a number of points in the submission which touch upon ideas which have been put forward to try to do rather better for people of that sort, and I think the universities themselves are also recognising that there is a more active career development role that they need to play in dealing with people who are their employees for a certain length of time but who are very unlikely to feature in their plans as an institution employing academic staff. They need to make sure that they are just not left to fend entirely to their own devices.

Lord Redesdale

397. Going back to the bulge that has been brought up in the age groups, you were saying that unless some sort of social engineering was accomplished this is going to be a problem that is going to reoccur. Considering that you are also looking for security of tenure how do you see that happening? If you gave somebody who was younger the job are you not then going to have a bottleneck in that position for longer?

(*Professor Brook*) You say I am looking for security of tenure, I do not think I said that.

398. Sorry, yes. If you were?

(*Professor Brook*) The engineering of the bulge, since it occurs in the university sector, seems to me to lie at the door of the university sector. They are the ones who make the appointments after all, they are the ones who choose the individuals to fill the posts for which we provide the finance. Therefore, we do look to them to make appointments which are rational for their long-term structure. If they do appoint, when a certain opportunity arises to fill many posts, a lot of people all of the same age then

[Lord Redesdale *contd.*]

they will have the problem that the cohort will grow older each year and will retire. That is a problem.

399. If that is the case would it not be realistic that the universities are going to appoint to the most senior positions the person next down the management structure, the next most senior people? Is that going to happen?

(*Professor Brook*) You are asking me to second guess how the universities will behave. There may be a temptation there and, after all, that person may be playing a role in many other things besides research and may have large administrative duties in the university or other skills which they wish to use as part of the university family. I think our role really is to look after the research quality. I was a little uneasy about the comment there that the grant policy is too elitist. I think one element within the funding system has to give attention to that. Also, the technical staff should be the best technical staff. I think if we depart from that in order to join the universities in their social engineering role the total activity may become diminished.

Chairman

400. Would you be open in circumstances where you had a relatively small university which was in a difficulty over melding—to use Dr Hughes' phrase—its Research Council funds and its HEFC funds, to an approach from a university which said: "We are in this difficulty at the moment over this contract, we think in terms of career progression of this person our view is this"? Would you accept from the university a kind of flexible arrangement in which somebody was allowed to continue for another year, possibly in return on some other contract for diminishing demand?

(*Professor Brook*) We would have no difficulty with that.

401. You would not?

(*Professor Brook*) No.

402. I think that is a very important point, if it is known that you would help some institutions.

(*Professor Brook*) Our procedures are, of course, now heavily inclined to use peer review as the process by which choices are made. We would invite the university to cast the proposal in the form where these factors were brought out. We would indeed ask them to choose a referee of their own persuasion, as it were, and we would then ask that referee to back up the statement being made by the university, namely that this melding is going to bring an advantage beyond what you would first expect. Then, of course, if the peer reviewers come and say "That is totally persuasive" then we would welcome it.

403. Can you tell us whether the universities are fully seized of this idea and using it?

(*Professor Brook*) We have had a series of regional meetings where Dr Hughes and I have toured the country. Wherever an invitation is received we go. We have a series of further regional meetings coming where we shall try to explain the changes which have taken place. We have had, I have to say, excellent advice from the academic community that has been most reassuring in that they think first as academic colleagues and secondly as members of a particular university. That has been extremely encouraging I have to say. The advice we have had has been helpful and we have used it to modify the system.

404. Perhaps we ought to move on to some of the other issues in front of us. We are particularly concerned, of course, as you know from the questions, with the problems of the MRes degree and also the situation of women in research and science. Would you like to express any opinion now on the MRes and your attitudes towards it in the paper?

(*Professor Brook*) I can say a little about it and then I think Dr Hughes, who has been responsible for the pilot scheme which we have set in place, can perhaps amplify it. You will be alert to the fact that the MRes proposal drew a mixed reaction from the audience. There were those sectors which liked it, engineering predominantly I think, and there were other sectors which did not like it; chemistry on the whole was not persuaded, but I have met individual chemists who have told me that it is an excellent idea. Confronted with this we believed that the vital thing to do, as quickly as possible, was to find out if the product from such a course was genuinely appreciated by the industrial sector. Therefore, we have set pilot schemes in place with that ambition of testing the MRes. We take those subject areas where we believe there is enthusiasm for it, to give the pilot a chance really, put it where people really want it; once we get some graduates placed in industry and can see if there is a demand from industry for more—'these are precisely the people we want, we find this one-year training very effective, the graduates move into our organisation smoothly, etc., etc.' That is the process. We have been, I would say, neutral in our approach to the MRes in making value judgments, we regard the pilot as an experiment. We have tried, I think, to conduct the experiment in the way where it can have the best chance of success.

405. You are genuinely open-minded and we cannot expect to have any assessment until four or five years down the road?

(*Professor Brook*) The first cohort will come out in summer 1996.

406. But you will need to see how they perform in industry, will you not?

(*Professor Brook*) Yes, but I think even a year later we will start to have an indication of whether they find employment—

407. Yes.

(*Professor Brook*)—or whether they predominantly wish to remain as doctoral students.

408. Yes. You will know that.

(*Dr Hughes*) There will be three intakes in the pilot, the first of which is October 1995.

409. Yes.

(*Dr Hughes*) So as Professor Brook said, the first output of people will be in 1996 and we will have some crude indicators then of a purely factual nature as to whether they all did get jobs of one sort or another: how many went on to do PhDs and if so where they may have gone and what subjects they followed, that kind of thing. The true evaluation, of

[Chairman *contd.*]

course, will take somewhat longer and that will have to be looked at very carefully.

410. Have you any idea, at the moment, as to people who are going on to this course and the universities doing it? Are they doing it primarily in the sense of a PhD or as a prelude to going into work?

(*Dr Hughes*) We have no idea yet because the actual pilot courses in our case actually have not yet been finally selected. The students on such courses will not appear until the late spring or early summer, possibly later. There was a strong level of interest in running the pilot courses, I have to say. We had 192 applications for an intention to run 15 courses.

411. 190?

(*Dr Hughes*) 192 applications to run courses from universities.

412. Multiple applications from the particular university?

(*Dr Hughes*) In some cases, yes.

Lord Dixon-Smith: Surely, Lord Chairman, the destination of the product, in a sense, will be determined by the person who interviews the student and it will depend, will it not, on his prejudices as to what he thinks the outcome should be? If he thinks these people are going to become useful in the research world he will tend to bias his selection in that direction. We are going to have a problem here to get an objective assessment.

Chairman: That is part of your assessment, I think, is it not, Lord Dixon-Smith, if employers want them they will pick them? Lord Craig, you wanted to ask something.

Lord Craig of Radley: I wanted just to follow up that point, I will leave it at that.

Chairman

413. If we could also explore your views on the problems of women in science and their career development which has special difficult features. You do say, I think, at some point that the problems of women entering science goes further back to the point of entry into the universities. Am I right in that?

(*Professor Brook*) We have had responsibility for the Daresbury Rutherford Appleton laboratories over the period from April 1 last year to this coming year. It was notable in that that when we looked at the fraction of people coming up for senior promotions' exercises, you could see the fraction of that laboratory staff who were women was really quite remarkably small, two per cent.

414. Two per cent?

(*Professor Brook*) Yes, of the senior workers within the Daresbury Rutherford Appleton laboratory, i.e, the ones who come in to consideration for promotion to higher levels within the laboratory, that fraction was very small.

415. Two per cent of the women only?

(*Professor Brook*) Two per cent of the group coming in to consideration for promotion were themselves women, yes.

416. Of the total staff what percentage were women?

(*Dr Hughes*) I think that we would have to send you information about the percentage of the total staff. Certainly it is not a figure that I carry in my head, except that it is larger than two per cent.

(*Professor Brook*) In other words they enter the system and then do not succeed to rise to the higher level.

417. Do they not succeed because of external factors beyond their control, though not entirely, or is it on merit?

(*Professor Brook*) I think there are many aspects here and I think the Council is particularly anxious—and I think that is true of all of the Councils working through the OST—to remove inhibitions which stand in the path of women undertaking a research career. In particular, we have had the embarrassment that where people were taking maternity leave, for example, the grant could be extended but at no extra cost and therefore no provision was made to bridge the period when the woman researcher was away. That is a quite mechanical bias in the system which we are removing.

Baroness Platt of Writtle

418. Good.

(*Professor Brook*) I think the first thing to do is to remove things like that which are quite strong in their influence, I suspect. We were in a position where a grant -holder in the university, choosing someone to put into a research assistant post, would have a clear bias away from a women because if she were to require maternity leave then that time would be lost from the grant. That has been corrected. I think we are looking for these rather hidden problems of that kind—quite deliberately looking for them—to make sure the system there becomes fair. I think the point made is correct that the sorts of physics and mathematics and engineering subjects which we do in schools can seem less attractive; there lies a problem and I suspect it will be many years before we come to the American picture where women have a larger participation in the research community.

Chairman

419. Yes, particularly in the university with which I am concerned, I see ever increasingly large proportions graduating in chemistry and engineering year by year. It has been quite noticeable in the last ten years how women are, as a proportion of the total, steadily increasing.

(*Dr Hughes*) To pick up a point Professor Brook was making earlier, if we look at our own staff, whether they are in the laboratories or in the Swindon office as scientific administrators, if you like to think of them as such, then it is true that at the more senior grades we have a very small percentage of women. We have one in Swindon, for instance, out of perhaps a dozen senior people, but at the lower levels actually we have quite a large proportion of women who have graduated in scientific subjects of one sort or another. I think there is that encouragement of seeing that things are beginning to change.

Lord Phillips of Ellesmere

420. Chairman, really I wanted to make a point and ask a question which covers the ground which has just been mentioned. It is my experience in universities that some subjects—crystallography, biology, medicine—are very attractive to women. There are very many women under-graduates who go on to a large number of senior appointments, relatively speaking, whereas what used to be called the hard physical sciences end, which is your area of responsibility, seems to be more difficult. Does that go beyond the lack of attractiveness of these subjects to girls at schools? Is there something else involved in it? Crystallography is a relatively hard science.

(*Professor Brook*) I would be very reluctant to say that there are harder sciences from some conceptual point of view which therefore induce sexual bias. I think that it would be hard to find evidence for that. The function of the role model we suspect is very important; in this connection, we have a scheme for the public understanding of science where we do take some thousands of our research students and get them to go into local schools to say what is involved in research, if you are in a school at 16, somebody who is 19 is already very, very much older and if we go beyond that then that is already a barrier. It is important that we get our women research students to participate in this and that is where a degree of almost positive discrimination, if I can put it that way, may be needed to ensure that they do participate in the exercise and do appear in the schools as successful, enthusiastic, practising scientists. That seems to be a place where we can be constructive.

Baroness Platt of Writtle

421. I endorse that. Certainly we have found in the WISE Campaign—Women In Science and Engineering—we need to dispel the myths, that is the key thing. I just wondered when you were saying about removing the barriers at the older age group when the women combine a successful career, they hope, with having a family, whether you studied the Commission on University Career Opportunities chaired by Dr Anne Wright because that has got quite a lot of useful suggestions as to how those difficulties can be overcome practically, economically and sensibly?

(*Professor Brook*) It is a failure on our part that with the impending departure of the Rutherford Appleton laboratory we have tended to look at this perhaps as someone else's problem. From 1 April we shall not have laboratories for which the Council is directly responsible. Our responsibility is then for laboratories within the university system through this indirect mechanism of providing funding. It is there where I think we can play a constructive role. We do not have direct management responsibility for laboratories following 1 April. Paul Williams, the Chief Executive at the Daresbury Rutherford Appleton laboratory, I think to his credit, is alert to the problem and anxious to correct it.

Chairman

422. We must not leave I am afraid questions four, five and six because these are matters of concern, as you will remember, from the White paper itself, the dual purposes one was improvement of quality of life and the other was the creation of wealth. Whilst earlier on I did comment on the fact that a large proportion of your particularly overseas fellowship holders came back and there was surely quite a considerable number who went into industry, on these questions four, five and six—and particularly five in which you say that your scheme for industrial fellowships has not proved popular and it is difficult to persuade people to opt for industrial rather than academic careers—can you tell us more about what you are doing in this field, whether the problem is getting worse or better? I imagine at the end of the day that judgments on what your Research Council are doing will partly be dependent on your contribution to the creation of wealth through the transport of materials as ideas on the hoof as someone put it.

(*Professor Brook*) I hesitate to say the matter is becoming worse because that is not something one ever wishes to say. However, I think the increasing role of the research assessment exercise and of teaching monitoring exercises within the universities is emphasising very much the central mainstream career pattern within the university. Therefore, in respect to such things as industrial exchange schemes, people will say 'they are good, of course we should do that, it is marvellous but you do not get credit for them in these assessment exercises'. Therefore, there is a risk that they become under-emphasised.

423. But you do have a scheme, as I understand it, in the Research Council called Realising Our Potential Awards which pay particular attention to this aspect, is that not so?

(*Professor Brook*) For the Realising Our Potential Award, the hypothesis is the following: that you find those research workers who can show that the path between themselves and industry is open, in other words information has flowed one way and finance has flowed the other way. Then we say that this is sufficient justification for providing basic science funding for that scientist because we know that, with that basic science funding, new ideas are likely to arise and we know that this pathway between the scientist and industry is open. There is a good chance that the information will continue to flow. It is a pretty good concept, I think; all credit should be given to the Director-General and I think it does fulfil the White Paper objectives. However, it is not so much concerned with movement of say someone from a university post into an industry post or vice versa.

424. It does, I think you will agree, put down a marker in that university that here is a member of staff who is actively trying to do this and that has an exemplary effect?

(*Professor Brook*) True.

Lord Phillips of Ellesmere

425. Could I just explore, my Lord Chairman, how that relates to the research assessment exercise. Do these people contribute to the Q ratings or would you wish to see some other elements introduced or amplified in the funding formula?

(*Professor Brook*) It will come into the assessment. Each panel is now asked to state the criteria by which it is making its judgments, that is the panel for materials, the panel for chemistry, the panel for engineering and so on. Certainly Research Council funding will be one of the criteria, I would be extremely surprised if that were not the case. The ROPA awards are, after all, Research Council funding so that the individual will get credit for that. Also industrial funding counts as a credit. I suspect in the engineering disciplines that will certainly be the case. The ROPA award is given to people who have enjoyed industrial funding. Consequently, someone who is doing well in the ROPA scheme I think will be a credit to their department in the research assessment exercise.

426. Then, my Lord Chairman, I do not quite see why someone coming on a short term appointment from industry might not also be a credit to their department?

(*Professor Brook*) Where would they appear in the exercise? Again these are decisions which will be made by the individual panel doing the research assessment exercise on behalf of the Funding Council. Those panels have been asked to publish the criteria by which they will be operating. It is possible that they will put industrial secondments or something of this kind among their criteria. All I can say is that the panel with which I worked in the last exercise did not have such an element within it, *mea culpa*, and I suspect that the physics group next time may well forget to include it. That is the risk.

427. Would you like to see them directed to include it?

(*Professor Brook*) Yes, I think it is a healthy criterion. If you have active industrial people coming into the department for a time and then returning into industry so that you know that they are valued by the industry from which they have come, it seems to me that this is excellent.

Chairman

428. It has to be a real experience on both sides.

(*Professor Brook*) Yes.

429. Well, now, we have gone over a lot of ground. I do not know if my colleagues wish to ask any further questions? If not, may I ask you if there are any points you would like to bring to our notice which we have failed to elicit?

(*Professor Brook*) Thank you again for the opportunity to be here and I wish you—I hope it is not impertinent—every success in your deliberations. We look forward to learning the outcome.

TUESDAY 28 FEBRUARY 1995

Present:

Craig of Radley, L.	Howie of Troon, L.
Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Dixon-Smith, L.	
Hilton of Eggardon, B.	Platt of Writtle, B.

Evidence from Dr Nancy J Lane, ScD, OBE, Department of Zoology, University of Cambridge

My attention has only just now been drawn to the call for evidence from Sub-Committee II of the House of Lords Select Committee on Science and Technology, on the subject of Academic Careers for Graduate Scientists.

I chaired the Working Party on Women in Science, Engineering and Technology (SET) for the Office of Science and Technology in 1993–94, having worked with William Waldegrave when he was Chancellor of the Duchy of Lancaster as I served as one of the Prime Minister's Advisors on the Citizen's Charter from its inception in 1991 to 1993. Our report, *The Rising Tide,* was published on 24 February 1994, and Government responded positively to it on 7 July 1994, by setting up a Development Unit for Women in SET in the Office of Science and Technology. This unit did not commence till 5 December 1994, so there has been little time thus far for it to make headway. However, our report considers the present position of women in SET in the UK and looks at ways of making scientific careers more attractive to women, in particular by greater flexibility in working conditions and hours. The problems inherent with short-term contracts is particularly pertinent as regards women, as they tend to be far more dependent on such contracts than men, mainly owing to their domestic and family responsibilities. This is clearly a disadvantage for them as regards their career security, and our data show that many women drop out of their scientific careers around post-doctoral time. The nation is therefore loosing a potentially very valuable scientific resource. There are a variety of approaches which may help to make careers in science more attractive to women, some of which are just beginning to be put into practice by certain enlightened employers. I am happy to give you further evidence on this should you wish it, either orally to the Committee, or by a written submission.

The University of Cambridge is also concerned about these issues, and has recently set up a committee, chaired by the Secretary General, and upon which I serve, to look into the development of the academic careers of women here in the sciences, mathematics and engineering departments. We have accumulated a good deal of information which might also be used as evidence by the Lords Select Committee; unfortunately, the immediacy of your deadline has meant that we could not get material to you by the 17th. We would be happy, however, to do so in the future, should you wish it.

Evidence from Dr Joan Mason, ScD, FRSC, Chair, AWISE

1. RECOGNITION OF THE LOSS OF WOMEN TO SCIENCE

1.1 I welcome this Sub-Committee's attention to the position of women in science. Before the comments in the White Paper *Realising our Potential* (1993), on the loss of human resource, there was little public recognition in this country of the magnitude of the drop out and drop down of women whose chosen career was in science.

1.2 The report of the Hansard Society Commission on *Women at the Top* (1990) drew attention to the lack of women in senior positions in the public realm, in corporate management, and in other key areas of influence, including the universities.

1.3 *The Rising Tide,* a report on Women in Science, Engineering and Technology (SET) (HMSO, 1994), written by an independent group of women scientists and engineers in the Office of Science and Technology, gave some documentation and made several recommendations. The Government's response *Women in SET* (HMSO, 1994) agreed to set up a Women's Development Unit in the OST and this is now in place.

1.4 The position of the average woman scientist as her children start school is often tragic. She may have 30 or more productive years ahead of her, but cannot compete in the job market with the rising generation, particularly in academic life. She is more expensive than a younger person, her mobility is limited, and she has lost valuable and perhaps crucial time. Many women could have as many productive years as most men, with good childcare, but this is seldom available. The UK comes very low in the EC league tables for publicly funded childcare for pre-school children, and for primary school children outside school hours.[1]

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[1] *Childcare in the European Communities 1985–1990,* Commission of the European Communities, Brussels, 1990; *The Key to Real Choice: an Action Plan for Childcare,* Equal Opportunities Commission, 1990.

2 CULTURAL INFLUENCES

2.1 A significant factor in girls opting out of physical sciences at school is that they have a lower expectation of a career than boys do, as popular culture directs girls' ambitions towards finding a partner and having children. In addition, there is the circular process that schoolgirls are deterred from science and engineering by the pattern of women's employment that they observe. Fewer girls will be lost to science at school when we achieve a broader curriculum at advanced levels as in Scotland or on the Continent.

2.2 There is a circular problem for couples, that a man's career is the more important, since he is likely to earn more as the woman look after the home. So the woman looks after the home, and her career takes second place when the man can move to advance his career.

3. PROGRESS IN THE UNIVERSITIES

3.1 Figure 1 *(not printed)* shows the rate of increase in the proportions of women among science students since 1971. In general the evening-up has been greater, proportionately, the greater the disparity, and is greatest in engineering. But given the decadic time-scale, the rate of improvement is much too slow, in the physical sciences and engineering. Regression in the mathematical sciences is explained by the expansion of computer studies, which have been taken up by many more boys than girls.

3.2 Figures 2–5 *(not printed)* show how women are lost to science at every stage, from undergraduate to postgraduate studies, then post-doctorally, and on the academic ladder. Even in Biology, where women outnumber men among the students, women are 5 per cent or less of Professors.

3.3 The cry is always "women don't apply" for academic posts. One answer to the Sub-Committee's question 6(b) is that only too many women who did choose science, and then see how few women are successful on the academic ladder, say to themselves "it's not worth trying".

3.4 Cambridge is perhaps an extreme example, following the general rule for women "the higher the fewer", whether in seniority within an institution, or institutional prestige. Cambridge creams off feminine talent, and the Part II class in Chemistry is now half female.[2] These students observe[3] that there is only one woman among the 48 university teaching officers in the Chemistry Department, that the former men's colleges have only 7 per cent of women among the fellows, and that the university's nursery has only 50 places for all grades of staff.

Cambridge University is laying stress on equal opportunities policies which include flexible working. A copy of a recent notice of Opportunity 2000 measures is appended *(not printed)*.[4] Table 1, giving the Cambridge figures at July 1994, shows that only 1 out of 109 women lecturers or assistant lecturers (in all subjects) is working part-time, as opposed to 97 out of 671 female contract research staff.

The University puts on the "Springboard" career and personal development programme, which was devised originally within the BBC. It is offered to women graduate students and assistant and academic staff, and has greatly helped young women with confidence-building and mutual support.

3.5 The expansion of contract research in recent years has increased women's opportunities, and the proportion of women is high among contract researchers, as shown in Figure 5. Many, however, are caught in a revolving door, and if they have to change field, so as to keep going, they may lose ground in career terms. Women on the "Springboard" programme tell me "my grant will not be renewed because I am now too high in the pay scale". Too old in their forties, and unable to relocate because of their husband's job, many then "drop down" into other science-related occupations. These occupations may well be worthy in themselves, but the women are lost to academic science.

3.6 The University Quality Assessment exercises are helping a few women and men whose research could not be counted because they were not on the establishment. A small number of university positions (5-year appointments as Assistant Director of Research) have recently been created with money put together from a number of sources which include funding agencies. Some women in the physical sciences are achieving in this way recognition they have sought for 10–20 years.

4. AGE-RELATED EMPLOYMENT STATISTICS

4.1 General employment statistics show women dropping out in their child-bearing years. As shown in Figure 6,[5] *(not printed)* a bimodal pattern is seen, particularly in the UK, as women return to work when their children start school. The minima span the period when there is a pre-school child at home.

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[2] I am looking into the destinations of these women.

[3] Joan Mason, "Women in Cambridge: some Quandaries", *The Cambridge Review*, June 1993.

[4] *Cambridge University Reporter*, 23 November 1994, pp 195–202.

[5] Figure 6 is taken from *Careers for Professional Women*, ed by Audrey Ward and Rosalie Silverstone, Croom Helm, London 1980, p 11.

4.2 Too few women return in this way to SET occupations, whether in industry or in the universities, as shown in Figures 7 and 8 *(not printed)*. Figure 7(a) *(not printed)* is a plot of qualified men and women in employment in SET using figures from the Labour Force Survey. The qualification is first degree or equivalent. For men across the age-range there is a broad hump (the shape of which is affected by demographic factors). For women there is a slow rise to a lower maximum at age 25–29, then slow fall-off to the retiring age.

4.3 Figure 7b *(not printed)* is a corresponding plot for academic staff in Biology for the year 1991–92. For university-funded men there is a fairly broad hump across the age range from 30–34 to the retiring age. For university-funded women there is a slower rise to a low peak at age 35–39, then a slow decline to the retiring age.

In contract research the proportion of women overall is about 50 per cent. There is a slightly higher peak for men than for women at age 25–29, and a slower fall-off for women after age 30–34.

Biology was chosen for this graph because of the substantial proportion of women. The numbers working part-time were too small to plot. The physical sciences show comparable patterns, but with very small numbers of women.

4.4 Figure 8a *(not printed)* is a more detailed plot, showing part-time as well as full-time working, of qualified men and women in employment in SET in 1992, using figures from the Labour Force Survey. For the comparision with 1981, in Figure 8b *(not printed)* figures had to be taken from the 1981 Census. Unexpected features of the profiles for men are again explicable in terms of demographic factors, in particular the low birthrate during the 1939–45 War and the baby boom that followed.

Figure 8a shows that the growth of part-time working for women from age 25 to 35–39 mirrors, to a degree, the fall-off in full-time working. Figure 8b shows that part-time working has clearly increased across the decade. The numbers of men working part-time are very small indeed.

5. Many people can now do a greater proportion of their work at home using information technology. "Tele-working" as such has not produced very great benefits for women, but some now have greater mobility in the job market through having a husband who works from home.

6. THE NEXT DECADE? LOOK AT THE LAST ONE!

6.1 The slow progress of women in SET in the universities across the 1980s is shown in Figures 9 and 10 *(not printed)*. The figures exclude externally funded research staff. Women were only 4.4 per cent of the total in 1980–81 and 6.9 per cent in 1991–92. The main increase in the proportion of women was in the 30–50 age group, while the male population contracted overall and aged somewhat.

6.2 Figure 10, giving the increases by grade from 1980–81 to 1992–93, shows that few women, still, reach any level of seniority. The percentages of women at reader or senior lecturer level in 1992–93 were 7.3 per cent in Biology (with 58 per cent of women among the students), and 1.7 per cent in Chemistry or Physics (with 35 per cent and 18 per cent of women among the students, respectively). In Chemistry the proportion at reader/senior lecturer level contracted by two-thirds across the decade, and there was no increase in the proportion of women lecturers.

6.3 Progress is unconscionably slow. In part this is due to the inertia of our institutions which date from the time when the profession was wholly male. The proportion of women Fellows of the Royal Society, just under 3 per cent, is no greater now than 30 years ago (Figure 11).[6] This does not help women's morale.

7. INTERNATIONAL COMPARISONS

7.1 Somewhat greater progress is seen in countries in which there has been greater recognition of the woman problem. In the USA, the Science and Technology Equal Opportunities Act of 1980 "requires the National Science Foundation to . . . increase substantially the contribution and advancement of women and minorities in scientific, professional and technical careers . . . and to report to Congress biennially on their status". The NSF has well-funded programmes for women and minorities, including Visiting Professorships and Career Advancement Awards. Other bodies make particular provision for women and minorities, thus the National Research Council and the National Institutes of Health have earmarked research grants for women returners.

7.2 Figure 11 *(not printed)* shows that US National Academy of Science has managed to maintain a steady increase in the proportion of women members since the 1960s, as consciousness of the need for equal opportunities began to rise in the US.

7.3 In Canada the Federal Department of Industry, Science and Technology issues a statistical profile of women in SET in universities and colleges and in the labour force, and has an action plan for industry. The

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[6] Joan Mason, "The Women Fellows' Jubilee", *Notes and Records of the Royal Society*, January 1995.

Natural Sciences and Engineering Research Council funds Women's University Faculty Awards (salary and research grants). Research Reorientation Associateships allow women PhDs who left the work force for family reasons to return to a research career.

7.4 The Royal Society of Canada has a Women in Scholarship Committee, and has had a five-year *Plan for the Advancement of Women in Scholarship*, 1989–94. Statistical profiles were published so that numbers of women elected to the Academies could be compared with the numbers in the pools from which they are drawn. No special procedures were introduced for the nomination or selection of Fellows. Simply by drawing the Fellows' attention to the need for equity for women, the proportion of women in Academy III (Science) was increased from 2.8 per cent in 1988 to 4.4 per cent in 1994.

8. Equal Opportunities in our Universities

8.1 The funding bodies (Research Councils, the Royal Society, the charities) are moving into greater flexibility of their arrangements, with portable fellowships or grants, part-time working, and some help for returners. They are also entering into partnerships with universities to establish positions for women where these are lacking, as mentioned in paragraph 3.6.

8.2 It should be recognised that departments and colleges admitting women students, often in high proportions, should arrange for women to be properly represented on the staff. There is no lack of advice on this subject, from the CVCP's Commission on University Career Opportunities (CUCO), Opportunity 2000, the campus unions and others. Necessary measures include:

encouraging qualified women to apply for academic positions as readily as men do

supporting childcare and part-time working in its various forms

helping women who are taking time out to "keep in touch", and to return

retraining programmes for women

recognising the forms of discrimination against women, including discrimination by age

monitoring progress and publishing the results (as is done for Government Departments by the OPSS and Public Appointments Unit)

8.3 Government action is needed

to improve equal opportunities in schools, in matters of the curriculum, classroom management, teachers' and parental expectations; not least, for schoolteachers. 1990 figures, showing little improvement compared with 1980, were, that in secondary schools, 48 per cent of teachers are women, but only 20 per cent of head teachers (cf. 81 per cent and 49 per cent in primary schools).

to bring in appropriate tax relief on childcare expenses; many mothers find it uneconomic to work

to monitor the representation of women in SET

to improve the funding of retraining programmes for women

Two schemes with an excellent trade record are the Daphne Jackson Scheme, and the Open University's Women Returners' scheme. Beginning with industrial funding, the Daphne Jackson Scheme is gradually achieving a broader basis of support.

The Open University scheme, which began in 1981 and ran successfully for over 10 years with funds from the Manpower Services Commission and its successor the Training Agency, recently came to an end when all central funding was devolved to 100 or so regional bodies, the TECS (Training and Enterprise Councils), LECs in Scotland. Because of the value of home-based study to women who have dropped out for family reasons, this highly respected scheme should be reinstated.

9. I conclude as I began by welcoming your Sub-Committee's considering the position of women in science. This question needs to be tackled at all levels, but as a democrat, I have observed with interest how much can usefully be done by action from the top!

At the same time, women need to stand up for themselves. To this end, we are founding the Association for Women in Science and Engineering, AWISE, for mutual support, and to link with sister bodies elsewhere, not least US AWIS, which has been running very successfully since 1971.

Evidence from Dr Anne Wright, Vice-Chancellor and Chief Executive, University of Sunderland

I welcome the invitation to make a written submission to the House of Lords Select Committee on Science and Technology in relation to Academic Careers for Graduate Scientists. My submission addresses in particular the issue of the position of women in science.

Question 1: what are the problems and advantages of the existing career structure for academic scientists in the UK?

1. The main disadvantage for academic scientists is that for many there is no perceived career structure: the prevalent pattern is one of short-term contracts linked to a research project, with an increasing dislocation between such contracts and an academic career leading towards promotion as a Reader or Professor.

2. The mainstream career appointment, carrying security of employment, salary progression and promotion prospects is a Lectureship, which carries responsibilities for both teaching and research. The route to appointment as a Lecturer is a minimum of seven years of undergraduate and postgraduate study. This minimum period may be followed by several temporary post-doctoral contracts. A postgraduate is likely to take on a temporary post-doctoral research assistantship followed either by a lectureship or by a demonstratorship and lectureship. This long apprenticeship entails career insecurity and a plateau of relatively low pay well into the period when both men and women may accrue family and mortgage responsibilities. The lectureship itself is on a long incremental scale which may in some universities be supplemented or accelerated, but is in general not designed to reward and encourage excellent performance in teaching and research, or scientific calibre. There is then a long period before promotion is possible, and sometimes a lack of clarity of promotion criteria, both for teaching and for research. The Senior Lecturer grade in "traditional" universities, and the Principal Lecturer in "new" universities, have an unclear articulation with Readerships and Professorships, and these latter may in turn cover either or both teaching and research.

3. The structure of funding for teaching and research in universities, together with current pressure on funding for teaching through efficiency gains and an increasing emphasis on research output and performance, can lead to an institutional financial interest in minimising the number of Lecturer posts to secure efficiency gains for teaching, while increasing the number of research posts whose term is fixed to a funded project. This is likely to be for many institutions the most efficient way of meeting teaching and research objectives. The benefits to science, and to external funders and commissioners of scientific projects including research councils, are that this is a sharply focused, performance-based system, which is task and output oriented. The disadvantage is that while it is on the whole an investment in science, it is not an investment in people, that is the academic scientists, on a career or long term basis.

4. Scientists wishing to focus on research and who can make a choice, may then be more likely to elect to work in industrial laboratories or government research institutes, where the career structure is more visible, with promotion routes directly through research, and where such establishments are perceived to fund people rather than solely on a project basis, through long term contracts of employment.

5. For scientists who wish to pursue an academic career which embraces both teaching and research the route may be long and hard. The financial structure of such a career is uncertain, with relatively low-paid contracts continuing well into the late twenties or thirties. The lack of an attractive career structure for academic scientists can mean that able and qualified scientists leave science, or reject academic careers, or are lost to the UK by a "brain drain".

6. The advantages and problems of the current career structures for academic scientists in the UK are not dissimilar for women and men, but are more sharply focused for women scientists. Loss of able and qualified scientists, women and men, is a poor return on public investment, viewing the education system as a whole.

7. The objectives of academic science, and of careers in academic science, must be to ensure volume and quality of science and scientists so as to build and sustain the UK science base and ensure good levels of scientific literacy, capability and expertise in the adult population as a whole. Academic scientists contribute to science today through research, and to science tomorrow through education and training of young scientists. A satisfactory career structure for academic science is essential.

8. It is also essential that academic science is an attractive and viable career for all groups including women, ethnic minorities, and people with disabilities. The issue is one of quality, of ensuring that science and academic science benefit from the talents and expertise of the whole community.

Question 2: what are the advantages and disadvantages of the growth in short term research contracts in academic science?

9. The advantage of short term research contracts is that resource can be switched flexibly as new research areas open and others close, by losing and replacing staff. There are therefore operational efficiencies and to some extent strategic advantages for universities in managing the resource to meet their objectives. This also works to the advantage of funding and research councils to produce a highly selective system based on performance and delivery.

10. However some of the apparent efficiency will be reduced by the need of researchers working on such projects to expend effort on finding the next project funding. During the period of short term contracts, many

will be looking to applications for the next contract in order to continue their career, thus lessening the focus on the current project and reducing effectiveness and productivity.

11. The inter-relation of short term research contracts and the progression towards a Lecturing post may serve as a disincentive to both men and women academic scientists. Undergraduates and postgraduates may see little future in academic research and look elsewhere for a career. The period of uncertainty coincides with the onset of family commitments, the need to secure income in order to obtain a mortgage, and so on. For both men and women this career structure may impede personal and family objectives and needs.

12. For women scientists wishing to make a career in academic science the pressures are sharper. The sequence of PhD, post-doctoral research and progression to further research or a lecturing post places a very high priority on continuity of effort. Many women scientists may perceive real difficulties in reconciling this with having and caring for a family. Provision for full maternity leave and childcare may be inadequate, and the concept of a career break irrelevant, for postgraduates, post-doctoral researchers and research assistants. Perceptions of such difficulties can affect both the women scientists, and also those who appoint them and who apply for the research contracts, who are usually men. The perceptions may be erroneous and outdated, but as long as they remain, they may inhibit the numbers of able, highly-qualified women scientists entering and pursuing a career in academic science. Universities and others can address organisational and employment factors impinging on academic careers for women scientists, to ensure that no unnecesssary obstacles remain.

Question 6: how do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?

13. There is considerable room for optimism in the statistics relating to girls and young women wishing to pursue science. Numbers of women taking "A" level science are increasing in several scientific disciplines, and where women take the so-called "hard" sciences, they are very successful. The increasing uptake of science by women at "A" level should be seen in the context of an overall increase in staying-on rates of girls post-16. It is part of an overall picture, over several decades now, of increasing educational aspiration, participation and achievement by girls and women. Because the phenomenon is so widespread, and so relatively continuous, it is not an easy task to make a definitive link with policies and initiatives. Nevertheless, it is possible that this improvement has been encouraged and facilitated by

- an emphasis on the importance of increasing staying-on rates at 16
- expansion of higher education
- the development of a National Curriculum which provides for all pupils to study science until 16 (although it is too early to be certain that the positive influence of the National Curriculum extends to post-16 uptake of science as a preparation for higher education).
- initiatives to encourage girls and women into science, ranging from in-service support for primary teachers of science, to WISE and school-industry links.

14. Despite the positive evidence of participation trends and achievement statistics, it would be unsafe to assume that the educational mobility of girls and women will automatically extend quickly to a corresponding increase in the numbers of women entering and pursuing scientific careers, including careers as academic scientists.

15. It can be tempting to assume that the increasing uptake by girls and women will continue despite any negative or counter initiatives, that it is for some reason historically inevitable. However, we need to monitor carefully the impact of cumulative often discrete policies and initiatives, such as the trend towards double science at GCSE; the impact of consolidation in higher education together with the perceived difficulties of student grants and loans on motivation towards higher education; the impact of GNVQ, Modem Apprenticeships and other vocational initiatives, to ensure that the facilitation and encouragement continues for girls and women to pursue an education and a career in science.

16. Statistics need to be interpreted carefully, to allow for example for the proportionate decline in the achievement of boys at school and college, as well as the decline in absolute numbers of boys taking science and engineering subjects. Moreover, the trends should be monitored to look for any decline in girls and women taking science and engineering, and moving on to higher education. Two years ago, it was possible to foresee a scenario in which the combined impact of the National Curriculum, growth in post-16 education, and pressure on places in arts and social science places in higher education might encourage women to choose science and engineering at "A" level to maximise their changes of gaining a place. That mix of factors no longer applies. We now have consolidation in higher education, growth in the FE sector and a rapid increase in uptake of advanced GNVQ. We need to go on looking carefully, then, at the position of young women in being eligible for a career in academic science by virtue of their eligibility for admission to an undergraduate science course.

17. At undergraduate level, numbers of women are increasing in many scientific areas, although fluctuations occur. In engineering and technology, national participation by women has increased over the

period of WISE to above 15 per cent. The proportions vary with the different engineering disciplines, and it can be much easier to recruit female students to programmes such as Technology Management, or Media Systems Engineering, or where engineering is combined with disciplines such as business and management, or modern languages.

18. Although women now equal or nearly equal men in terms of undergraduate numbers, there are still large disparities at postgraduate level. The continuing relatively low proportion of high-achieving women science graduates who take the next step of applying for postgraduate research places and funding suggests that at this crucial juncture the phenomenon of raised educational aspirations does not occur and perhaps confronts other factors. It is essential to monitor this watershed between first degree and postgraduate study and research. A continuing disproportion between graduate achievement and postgraduate participation for women scientists should be addressed by universities, research councils and other agencies.

19. We need to look at the breakdown by sex of graduates in science proceeding to further study, and in particular to a PhD, to determine why it is that in many areas the gender balance at postgraduate level starts to weigh in favour of men. Overall, and even where undergraduate numbers of women and men are equal, fewer women proceed to a taught postgraduate programme or to research. Our experience of the educational mobility of girls and women may suggest that participation at postgraduate level will increase, and that this will gradually and automatically lead to a greater representation of women as academic scientists. However, at this juncture, factors other than the factors promoting earlier educational aspirations may come into play.

20. The structure of academic careers in science may be a factor here, as may the lack of structural and institutional provision for women with families through conditions of service, maternity leave, childcare provision and career breaks. A further factor may be the perception of academic science, and in particular the research culture and community, as overwhelmingly male. There are several issues here: senior women role models are few, and perhaps even more importantly more junior female role models are relatively few, Appointments and research contract applications (which are submitted by permanent postholders) are made by men, who may not have recent staff development in recruitment principles and practice to guide them. There may also be "lag" in the raising of aspirations at completion of the undergraduate programme, so that women would still regard postgraduate achievement as beyond their reach. We need also to look at completion rates by women and men in relation to PhD programmes, and if possible relate these to reasons for non-completion including family reasons.

21. The imbalance continues and sharpens progressively in academic careers. In 1993 women represented 23.8 per cent of full-time lecturers at all grades in new universities. The grade distribution within this overall figure was however 45.6 per cent of Lecturers, 24 per cent of Senior Lecturers, 14.7 per cent of Principal Lecturers and 12 per cent above Principal Lecturer. The grade distribution by gender in old universities was 15.9 per cent of all full-time academic staff, with 33 per cent on the Lecture A scale, 20.2 per cent on Lecturer B, 10.2 per cent of Senior Lecturers, and 5.5 per cent of Professors. (Source: Commission on Career Opportunity Survey, June 1994).

22. Within the overall figures for undergraduate, postgraduate and academic careers, there remain substantially higher imbalances in science, engineering and technology subjects. *The Rising Tide,* the report of the OST Committee on Women in Science, Engineering and Technology, indicates that "most of the additional higher education places in SET which arose as a result of expansion in higher education between 1988 and 1991 were taken up by men. Moreover although the number of full-time women postgraduate students in Great Britain increased by nearly 50 per cent in the same period, women are still only 27 per cent of full-time science postgraduates and 10-25 per cent of students in engineering, mathematics and the physical sciences." The same report shows that women accounted for only 15.5 per cent of full-time academic staff in SET at all grades. There are sharper imbalances within SET, both by scientific discipline and by grade, with the overall effect that 1995 still saw the appointment of the "first women professor" in one or more disciplines.

23. The picture is more positive if new entrants to academic careers are looked at, rather than the overall cohort. The proportion of women appointed to lecturing posts, and to professorships, in the last five years is higher than the overall figure. There is thus some evidence of improvement, which might lead to an expectation that the next decade might see a substantial change in the profile of women in science. This is perhaps the most crucial point, and the strength on which further promotion of academic science as a career for women can build. In each generation, and at each stage of education, more girls and women are choosing science.

24. It is clear nevertheless that more work needs to be done in emphasising academic science as a career choice for women, both to women themselves and to men in academic careers. We need to look for example at advice and encouragement given to students at the final stages of undergraduate programmes; at the relative proportions of women and men gaining firsts and upper seconds who apply for postgraduate and research places; at training in equal opportunities for academic staff responsibilities and supervision of postgraduate and research students; at publicity and promotional material; at supervision arrangements and student support arrangements, including childcare; and at completion rates for women and men.

25. At post-doctoral level, universities and research councils can ensure that recruitment to research posts accords with good employment practice. This would mean external advertisement of posts, together with

appropriate procedures, and training for all staff involved in appointments. Research councils and universities should together address the implications of calling for named researchers on funding applications, insofar as this practice can limit the pool from which future scientists is drawn to a particular group.

26. Other critical junctures should be monitored, and the implications of monitoring addressed. This may mean looking at appointment procedures (including training) and at promotion criteria and practice, in the context of overall career structures and employment practice.

27. Some work has already been done by the Commission on University Career Opportunity, which I chair. The Commission was launched in 1994 under the auspices of CVCP. The Commission (CUCO) aims to assist universities in developing and implementing policies which will ensure maximum benefit from the abilities and talents of all sections of the community in the recruitment, deployment, development and promotion of university staff. The Commission comprises a group of Chairs of university Councils and Boards of Governors, vice-chancellors, senior administrators, trade union representatives, and private sector people with extensive experience of developing fair employment practice.

28. In 1994 the Commission published a Survey on equal opportunity policy and practice in the university sector. The survey showed that while all universities had in place a policy, only 37 per cent were working towards delivery of an action plan. An encouraging proportion had in place equal opportunity and fair recruitment training, but such training was compulsory for all staff involved in appointments in only 21 per cent of institutions. In general universities lag behind employers and professions in other sectors including the private sector in the development and implementation of policies and action plans designed to ensure benefit from the best talent available.

29. The Commission has now established expert groups drawn from the sector to advise on a number of areas, including childcare provision, positive action within the law, implementing policies, recruitment and promotion policies and procedures. These working groups are due to report to the Commission in spring 1995.

30. There are therefore a number of points and issues which need to be addressed:

(1) progression from first degree to postgraduate study and research
  - encouraging women students to apply and progress
  - academic counselling and career advice
  - training and staff development for supervisors
  - positive action such as Women into Science bursaries
  - funding arrangements and procedures
  - age requirements by universities or research councils which may discourage mature women graduates or women taking career breaks
  - study, research and employment conditions, including recruitment procedures, terms of employment, maternity leave and childcare provision

(2) progression from research to academic posts
  - recognition by universities of the importance of recruiting women science lecturers and researchers
  - implementation of equal opportunity policies so as to increase the numbers recruited, by fair recruitment policies and procedures, training and staff development, adoption of initiatives such as Opportunity 2000
  - ensuring that a "masculine culture" of science does not predominate.

(3) progression and promotion to senior posts
  - promotion critera and procedures, job and person specifications, continuity expectations or requirements, age requirements role models
  - training and staff development

31. In addressing these issues universities may benefit from advice or support from bodies such as the Commission on University Career Opportunity, the Equal Opportunities Commission, and UCosDA, which is the CVCP agency for staff development in universities. The research councils, the Royal Society and professional bodies and associations can also assist by looking at matters over which they have control or influence.

32. Most of the factors I have outlined apply generally to women in employment, and can be addressed by applying the principles of best employment practice to the particular area of women in academic science. Perhaps the two most important and practical aspects are first, recruitment and employment policies and procedures, and secondly training and staff development.

33. There remain, however, issues of stereotyping which apply specifically to women in science. Stereotyping inhibits the participation of girls and women in science, and can prevent girls and women from fulfilling their potential as scientists. Stereotyping can apply at all levels of education and academic employment, and accordingly needs to be addressed from nursery education onwards.

- Nursery and early years provision should ensure that sex stereotyping in relation to science and technology is avoided, through education, training and staff development.
- Primary science provision should ensure that the curriculum and its delivery, including classroom practice, provides a positive and expert scientific education for both boys and girls. This may involve special initiatives for teachers of primary science, many of whom are women and who are not scientists. Schools should ensure that girls are not deterred by relative lack of access to facilities including computers.
- There is evidence that girls are more likely to succeed in science at school in a single sex environment. Such an environment is available in single-sex schools, and can also be created in mixed schools by sex-streaming or by science clubs.
- At secondary level, the impact of the National Curriculum and of GNVQ should be carefully monitored, and staff development provided to ensure that teachers promote science as a career for women. Careers advice and careers services should explicitly address women and science.
- Particular effort should be paid to geographical regions where historical patterns and attitudes show lower participation by girls and women in science and in post 16 education.
- Particular effort should be given to the recruitment, education and training of science teachers.

CONCLUSIONS

34. Overall, the interplay of factors can lead to many able, qualified and otherwise motivated women scientists being lost to science careers, and lost to academic science careers. All women, like all men, will continue to make individual life and career choices which may include leaving science. The important point is to facilitate positive choices and to make sure that no unnecessary obstacles stand in the way of the UK benefiting from scientific talent.

35. It is unsafe to assume that the statistical educational mobility of girls and women in recent years will of itself automatically lead to greater numbers becoming academic scientists in the next decade. Policies and initiatives are needed in education and academia, in industry, in research councils and scientific bodies, and in governmental departments.

36. Making scientific careers more attractive to women is a matter of looking at all the points in the progression towards such a career, from the earliest years right through to appointment and promotion as an academic scientist.

37. Policies and initiatives should take a problem-solving approach to the crucial junctures at which women scientists make choices and decisions which can lead to a career in academic science.

38. Examples of such initiatives might be a WISE initiative targeted specifically at women students of science in universities, linked to networking with women scientists already working in academic or research posts. Another route might be to promote an academic science equivalent of Opportunity 2000, aimed at universities, research councils and other bodies.

39. Whatever special initiatives may be devised, recognition of the importance of encouraging women to develop and sustain science careers must also be integral to all education, research and employment policy development. The impact on the uptake of science by women of changes in policy and new initiatives should be monitored.

Examination of witnesses

DR NANCY J LANE, ScD, OBE, University of Cambridge, DR JOAN MASON, ScD FRSC, Chair, AWISE, and DR ANNE WRIGHT, Vice-Chancellor and Chief Executive, University of Sunderland, called in and examined.

Chairman

430. Welcome to the Committee. We did have a word outside and the Committee have agreed that it would be a sensible thing to take each of your submissions in turn and to go through them with you, in which case I should like you to feel absolutely free, those of you whose paper is not being discussed, to put in whatever comments you would like to when you think it is appropriate. I hope that that will prove agreeable to you. We shall try also—I will ensure—to see that the questions of which you have been notified are covered. Would that be agreeable? Thank you. Who then would like to begin? Dr Wright?

(*Dr Wright*) My Lord Chairman, I welcome the opportunity to come to the select committee. I think that you have a copy of my submission which attempted to cover a number of the questions which

[Chairman *contd.*]

were provided but not all, and I wanted particularly to focus on the issue of women in science. I started off in my paper by addressing though the problems and advantages of the existing career structure for academic scientists and in particular the mainstream career appointments and the route to such appointments and the prospects of promotion from them. It does appear, as I say in the early parts of my paper, that the career structure for academic scientists and perhaps particularly for scientists who wish to focus on research is one that can inhibit participation in such careers, particularly in view of the preponderance of short term contracts and the route towards a mainstream career through such contracts. It appears to be the case that for many scientists and prospective academic scientists the prospect of the early part of the career being spent in short term contracts carries with it a deterrent in the form of job insecurity and a less than visible, shall we say, prospect of career progression. Now I say in my submission that the issues attaching to the career structure offer disadvantages to both men and women scientists and those disadvantages are not really different in kind, but it may well be that they are sharper for women scientists in particular because of the stage of their life as well as their career at which the short term contracts are likely to apply to them. So for both men and women, for example, who are entering in their twenties perhaps or early thirties on family responsibilities, the career structure available can be a little daunting in relation to financial responsibilities such as mortgages and also in relation to family responsibilities including child care, but for women in particular the timing on this may be acute and it may unnecessarily face women in my view with a choice between a scientific career and the kind of life prospect that people naturally have at that stage of their lives. There may well be advantages of such career structures, however, and I think that it is very important to be aware of that. The advantages on the whole lie not for scientists probably but for science and for others. It is a system which is very project and task focused which concentrates on funding projects and funding science and correspondingly for universities and for funding councils and for research councils there may be advantages in the extreme selectivity and the kind of competition that is provided. But on the other hand the down side of that is that through funding projects, if you like, and funding science we may miss out on funding scientists and therefore lose out on the long term prospects and long term opportunities of encouraging both men and women, and particularly women, into careers in science. Therefore it does seem to me that there are disadvantages and they need to be addressed. I turn then, my Lord Chairman, in answering question number six to the prospect for women in the next decade and I start off by saying that there is considerable room for optimism in the statistics relating to girls and young women wishing to pursue science, and that seems to me to be very important indeed. Numbers of women taking 'A' level science are increasing in several scientific disciplines, and where women take the so-called hard sciences they are very successful. This is part of the overall increase in staying on rates in education, aspiration and achievement of girls and women post-16. It is a widespread phenomenon and it has been continuing now for many decades, so there is a very positive picture on the whole. However, despite that it seems to me unsafe to assume that the educational mobility of girls and women will automatically extend quickly to a corresponding increase in the numbers of women entering and pursuing scientific careers for a number of reasons. It is always important to look at the impact of often discrete policies and initiatives like, for example, the national curriculum, more recently, the introduction of GNVQ and so on, and we need to go on monitoring those initiatives because they are uncertain in their application and effect. But perhaps more importantly, even though numbers are increasing of women, they are not increasing quickly enough. At postgraduate level certainly numbers of women start to fall off across all disciplines and particularly in science, engineering and technology, and this must be a matter of concern. We could say that we have succeeded in raising the educational aspirations and achievements of girls and young women, but we have not yet managed to enable women to carry that through perhaps into postgraduate level and into research. If we waited for time to take its course we might succeed, but that would take many decades. The more important point is that the factors affecting or inhibiting women from pursuing postgraduate research may well not be connected with educational aspiration and achievement; there may be other factors like the career structure, the kind of support that is provided for women through maternity leave and child care and career breaks, and perhaps even the overall image of science and scientific careers as predominantly male. Therefore, although it is a positive picture I would suggest that we cannot leave time alone to provide women scientists. We know that we do need more scientists, more able scientists, both women and men. We have the positive picture of girls and women being the group in which participation in education is increasing most rapidly and we should build on that. I would hope that we can build on the kind of initiatives that we have already seen and encourage this development further. This will mean universities and research councils and funding councils and other bodies looking—and perhaps looking together—at the kind of factors which might inhibit progression and taking steps to address those. Individuals will of course always make their own career and life choices, but it is the case that organisations can take steps to identify obstacles and remove those obstacles where the organisation itself can address them. My Lord Chairman, I think that that covers the general points that I would like to raise.

431. Thank you very much, Dr Wright. May I just be a little bit of a devil's advocate. We are charged, of course, to look at it irrespective of gender so there is one point that I would like to put to you at the very outset. Some people have maintained that this is a bad system overall that we now have, but many people also say, is there any reason why research scientists should be immune from the economic pressures that prevail generally and should they have the expectation of continuing their job as research

[Chairman *contd.*]

scientists throughout life, what are their destinations going to be. Not all of them can come into universities for the obvious reason that we know that all the places are full and it is not very mobile a system as yet. Do you have any observations on that which could help us because it is also true certainly that there is no hope of extra money from research councils or funding councils at the present time which would solve this problem and bring us through the next ten years to the position when, to use a not very attractive metaphor, the aged drop off at the end as the age group moves upwards and retirements become due? Do you think that we should have premature voluntary retirement, new blood appointments and so on instituted now? A lot of questions there!

(*Dr Wright*) Yes, my Lord Chairman, there are a lot of questions there. Certainly I incline to the view that where we perceive there to be problems then it is important to take positive steps and to have initiatives of the kind that you mentioned like early retirement or young blood appointments or certain particular kinds of fellowships, perhaps returner fellowships. The very interesting point that you have raised is whether the kind of career structure or lack of it that is at the present time perceived in science is one that far from being reduced in a certain part of employment may well increase across a range of disciplines, that is, that we expect young people to need to engage certainly in a number of jobs and possibly in a number of careers through their adult life span. I feel, however, that while that is a trend that we can foresee and anticipate there is a real problem in relation to research scientists which can be addressed in the here and now, so while it would be wrong and false to try to assure research scientists that there will be a job for life or even a career for life, nevertheless, I feel that we can take steps to encourage people to come into research science and progress in that way.

432. But again I am going to be devil's advocate and say that if one was looking at this from a classical economics point of view you would say there is simply an over-production?

(*Dr Wright*) That is why, my Lord Chairman, I pointed out a little earlier saying that there may be advantages or there may be perceived advantages for science in the extreme selectivity and competition, but if you do take the longer term view and offer progression of individuals towards achievement and excellence in their scientific area over a life time, then it could be argued I think even on economic grounds that there is a net loss. There is a net loss to the nation anyway in the investment which has already been made by this point in people's lives in their scientific education, and we are losing on the investment that we make if we do not provide appropriate career structures for people.

433. Are you saying, taking the Darwinian approach of natural selection, that because there is competition there is more likelihood of the best ones surviving and continuing in the system and therefore that is desirable?

(*Dr Wright*) Yes, my Lord Chairman, if it were that kind of competition. In essence what I am saying, I think, is that we have a very competitive system at the present time, but if we want it to be competitive in a way that will make sure that the most able people are able to continue, then we may actually be providing the wrong kind of competition at the present time in the wrong way.

434. In this connection, of course, you feel that women are specially disadvantaged because it is highly competitive?

(*Dr Wright*) Yes, not because it is highly competitive—I would not for a moment say that women could not compete on grounds of ability, and, indeed, that is what I am urging, that women are enabled to compete on the basis of ability. What I am saying is that while we have now I think on the whole enabled girls and women to compete on grounds of ability in our education system probably up to the end of first degree level, there may well be factors after that point that are not to do with educational aspiration and achievement and which could be and, indeed, are, removed in other occupational sectors. Therefore, in the private sector, if I may just finish, my Lord Chairman, we see that people do make such provision.

435. Perhaps I may just pursue this because I am trying to clear the ground for the background. The next point is then this. You see no disadvantages and every advantage in encouraging more girls and women to go forward in these careers so that we are not losing the pool of ability that lies there. May I then ask you about the question which comes out in your paper which seems to me to be one of the crucial factors, which is the deterrent effect which secondary school curricula have on girls at least in mixed schools though not in single sex girls' schools: ought one not to start at that particular point?

(*Dr Wright*) As I suggest in my paper, I think, my Lord Chairman, in my view if we do agree that we want to encourage women's ability to become scientists, then we have to look at this at all stages in education. Many steps have been taken in early years' education and also in secondary curriculum, but I have no doubt that we need to go on addressing that throughout and that is why I say that I do not think that we can leave time alone to solve this because there are too many factors at play. We certainly do need to look at the curriculum both at school level and probably at university level.

436. You do say that there are means by which you can encourage girls at the school level, but there is no evidence in your paper of that having worked. Do you have some?

(*Dr Wright*) There are increasing numbers of girls and young women taking science in certain disciplines, both at GCSE level and at 'A' level, and, indeed, there are encouraging signs of increase which we would—

437. But are these a proportion of the age group?

(*Dr Wright*) As a proportion of the overall age group the proportion I understand from other sources has remained fairly constant for a considerable time.

438. Yes, which means a smaller proportion—the same proportion but a larger number?

(*Dr Wright*) That is right, so there are increasing numbers. But I think that the main point that I would

[Chairman *contd.*]

make is that we have succeeded, as I have said, in encouraging greater numbers of girls and women in proportion within the gender balance to participate at the age of 16 and at 18 at school and college and at university. It is a shame, it seems to me, if we are not encouraging more to become scientists if we believe that it is important for us as a nation to have more scientists.

Chairman] Well, of course, there is a general argument which we have not deployed because we are concerned with research scientists that science is a great cultural activity and should be part of everybody's life.

Baroness Hilton of Eggardon] My Lord Chairman, I wanted to pick up the Darwinian analogy. Darwinian evolution of course does not depend on picking the best or the person with the greatest ability; it depends on picking the person who fits best into the system, it is the fittest for the particular environment. If you have an environment which militates against quite often those with ability, not only women but men as well sometimes, and current pressures sometimes seem to do this, what you may in fact be selecting is people who are most mobile, most able to do short term projects and working against those who may in fact have the greatest ability and be the "best". I really wanted to pick up your analogy about Darwin which I thought actually fits very well but with a slightly different slant to it.

Lord Craig of Radley

439. Dr Wright, in your opening remarks you made a comment about the need for organisations to remove obstacles and you touched on one or two more general points about encouraging at various stages the child and then the young person's advance and ways in which it might be done for an individual. I wondered whether you would like to comment on such things as what the Wellcome Trust call their career development scheme? Is that the sort of organisational improvement that you would like, and are there any others that you could draw to our attention?

(*Dr Wright*) Thank you. I am sure that many agencies like the Wellcome Trust can look to their own provision and see what adjustments they could make, particularly fellowships or development fellowships which allow people to develop their career whether it is to overcome factors of age limitation or mobility or continuity and security of tenure, so those kinds of issues are ones which research councils, funding councils and others can address. Similarly universities can address issues in their own employment conditions and procedures and criteria for selection for promotion and very often it is the case that without realising it organisations are placing obstacles in the way of a particular group and in my experience steps can be taken to overcome those obstacles. Some of those will be specific like the ones that you have mentioned in the Wellcome Trust. Some are very general; they are about looking at appointment procedures and criteria, they are about looking at training and awareness and staff development, they are really very general matters, but ones which can improve the position in any kind of organisation, including science.

440. But you would not rule out, would you, at least a proportion of short term contracts as a necessity in the real world of the type of science research that is going on?

(*Dr Wright*) I would not rule those out. It may be that in partnership in the sense of looking together at these issues that scientific bodies and universities can come up with arrangements which allow part of the funding to go to the person and part of the funding to go to the project, which would allow at least for both the short term needs in the area of competition for excellence in relation to a project and also the necessity of nurturing individuals over a life time in science.

Chairman

441. Is not one of the crucial facts that on the whole when making appointments, particularly in a first established job—I will not say permanent job because tenure has gone—academics are looking for people whom they can rank on some absolute scale and the only guide that they think they have—and I emphasise, think they have—is published work and past experience, and that maximally disadvantages women in the age range round about 30?

(*Dr Wright*) Yes, that may well be the case, my Lord Chairman, and that is exactly why it is important to look at procedures and criteria and review those as appropriate. It is not for the benefit or only for the benefit of the individual applying; it is for the benefit always of the organisation and ultimately for the benefit of science.

442. But how do you assess the potential for the next 35 years with male applicants with a track record and a woman who unhappily does not have one? This seems to me to be the practical issue in an appointments committee.

(*Dr Wright*) These issues are always very challenging, and they are challenging wherever they occur, whether in science or in university or in other organisations. I think that the best way of approaching these issues is to make sure that the people who are concerned with making appointments do have an understanding of the kind of issues that arise and are aware through staff development or through training of ways in which they themselves can approach these difficult tasks. They will always be concerned to appoint the best person irrespective of whether that is a man or a woman, but there are ways. We have experience now of looking at profiling of people, for example.

443. Profiling?

(*Dr Wright*) The profiling of people who come back as mature students into education in a way which will take account of their previous experience or their previous learning but without having only to read across, as you suggest, from a list of publications, so we have developed ways in education as a whole of looking at people's prior experience so that one can even up the candidates to make sure that the best is appointed.

[Chairman *contd.*]

444. I would not like to be unfair about this. Are you saying essentially that you have methods which are reasonably reliable of identifying potential other than the normal sort of criteria?

(*Dr Wright*) It would be a development of the accreditation of prior learning which essentially assesses people's ability to progress to a next stage, but there would be advantages in raising awareness, I think, and giving staff development to people of the kind of experiences or abilities that they could look for in candidates who do not present themselves in what they might think of as a traditional way.

445. And this is reliable, is it, as a method?

(*Dr Wright*) As reliable as any method of selecting candidates can ever be!

Baroness Platt of Writtle

446. I read your CUCO report and obviously I found it very interesting and matching in many ways, as you have, the experience of WISE over a ten year period. I think that the WISE campaign has been very fortunate in the number of people that it has worked with which has enabled success to be achieved. I notice what you said earlier today, the importance of bringing people together. I wonder what you thought of the idea, which is mentioned in other papers, of universities together with research councils and anyone else who is interested developing a code of practice? When I was chairman of the Equal Opportunities Commission we developed a code of practice which proved very useful as a tool in the hands of employers to see how to avoid discrimination and also to be used as a tool in the training that you have mentioned.

(*Dr Wright*) I must say that I think that that would be an excellent development. Because there are a number of factors at play as I have already said and therefore a number of organisations which really are stakeholders anyway in the outcome of encouraging women into science it would be a tremendous development to have a code of practice which was developed by working together between those various bodies. Individual sectors can also have their part to play so that developing a code of practice or guidance as CUCO[1] is attempting to do for universities is very helpful, I think. I would see a national development of the kind that you have mentioned being very valuable. I should like to add one to that, if I may, my Lord Chairman, as well, which builds on the experiences of WISE, as you said. That is that in the University of Sunderland we are currently developing a science policy statement arising from the White Paper—

Chairman

447. Will you tell us who "we" is?

(*Dr Wright*) The university of Sunderland.

448. Your university?

(*Dr Wright*) Yes, my Lord Chairman, we are developing a science policy statement. This is after the White Paper, Realising Our Potential. The academic board of course debated that paper and its implications for research, but we quickly realised that our influence and our activity as a university which has a wide range of science activity extends really throughout the spectrum that we have been talking about. We train teachers of primary science. We train people in undergraduate degrees in science and across a very broad range. We train research scientists and we do research. We also work very closely with industry and business, including in the area of scientific related research and applications, and what we have decided to do is to develop a science policy statement which will cover all of our commitment and our activities as a university which will form part of our own strategic plan, and we hope to consult locally—and this is an important point, I think—and regionally colleges and schools and industry and business and other stakeholders in the science so that we get a local and regional commitment to science which can then form the basis of an action plan. I believe that this kind of working together—because we are talking about young people and men and women throughout their adult lives—across sectors to promote science and scientific excellence could be very valuable.

Lord Dixon-Smith

449. In your opening statement, Dr Wright, there was a hint at one stage that if we were producing scientists and there was not enough science for them, then we should produce the science too, in other words, there is an imbalance between the nation's education investment in this field and the use that it then makes of the product, if you like. In my limited experience, which goes over some time but not across all fields, I have never seen a balance yet between educational output and the employment field in general. It occurred to me that you were answering your question as to whether the funding councils should in fact fund science or scientists in part and I wondered whether that was actually what you intended? Then there is a second question. If we go back to the remit of the sub-committee, which is academic careers for graduate scientists, and the concern at the large proportion of short term contracts if you like which have to be indulged at the present time, is not the answer to this already within the universities' hands in that they could take this matter in hand and correct it if they wished? It has

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[1] *Note by the witness:* The Commission on University Career Opportunity (CUCO) was launched in 1994 under the auspices of the Committee of Vice-Chancellors and Principals (CVCP). The Commission aims to assist universities in developing and implementing policies which will ensure maximum benefit from the articles and talents of all sections of the Community in the recruitment, deployment, development and promotion of university staff. The Commission chaired by Dr Anne Wright, comprises a group of Chairs of University Councils and Boards of Governors, Vice-Chancellors, senior university administrators, trade union representatives and private sector members with extensive experience of developing fair employment practice. In 1994 the Commission published a survey on equal opportunity policy and practice in the *Continued from page 11* university sector. The survey is to be followed by publication of advice on areas including recruitment policies and procedures, promotion, childcare provision and job share and career breaks.

[Lord Dixon-Smith *contd.*]

not been a problem that they perhaps have had to address until now, but it is becoming increasingly so and, of course, that follows neatly on from what my good friend Baroness Platt was saying a few minutes ago about a code of practice.

(*Dr Wright*) On your first question, of course, it is always a perennial issue as to how one achieves a balance or whether it is desirable to attempt to achieve a balance between educational profile overall and employment and prospects of employment, and universities have always been and will always be subject to that particular tension ourselves because we are required in my view on behalf of the nation and on behalf of the public both to meet the short term needs of industry and the business end of employment and also to take the longer view. It is of course the case, perhaps particularly in science and engineering and technology areas, that if we make very radical short term adjustments to meet employment and occupational trends, we may risk disinvestment which actually carries a very long term effect, and perhaps that is the answer to your question about science and scientists, and I worry a little about comments that are made currently in relation to any sector, perhaps particularly to science, that we have too many scientists or that we have too many engineers. I find that worrying not because of the statement in itself but because of the consequences of it which could be quite deleterious.

Chairman

450. Would you repeat that last part, please?

(*Dr Wright*) The consequences of assessing the need for scientists and engineers over the longer term, that is, over individual life times, in relation to very specific current perceived employment needs can be deleterious for two reasons. One is that if we disinvest in science and engineering education it can take a long time to rebuild that; the second is that because we are talking about individuals over their life times if the chance is lost, although we have many schemes to bring people into science later in their careers, it is a wasted investment in people. Therefore, I worry a little bit about having very strong steers in relation either to more scientists or particularly to fewer.

Chairman] Before I ask Lord Phillips to come in may I just make an observation? If the time constant of two systems which are interacting are different, any match that you may get can only be momentary. This is the great lesson of the manpower planning of the sixties.

Lord Phillips of Ellesmere

451. My Lord Chairman, may I go back to a rather earlier stage in the process. I wonder whether you would agree, Dr Wright, that a very large proportion of girls in this country are still brought up at home in the expectation that their career will consist of getting married and having and raising children? When they get into this situation, whatever work they may have done in the interim, a lot of young women rather strongly take the view that it is their duty to spend at least the school years of their children up to the age of five in close contact with them, looking after the children themselves, so this means that a young woman who embarks on a career of any kind, any professional sort of career, is likely to have a five to ten year break in it if they follow this philosophy of what is a young mother's responsibility. It seems to me that if that analysis has any merit in it at all there are bound to be a smaller proportion of women entering the professional career system—and I do not just mean scientists—than there are men and in respect of those that do enter there will be quite a proportion subject to a career break. That leads me therefore to two questions at the two ends of that spectrum of thoughts, if they can be regarded as thoughts. At the beginning should some emphasis be put on changing parents' and girls' expectations about what their career opportunities and futures are extending beyond marriage and child bearing? That is a complicated bit of social engineering to think about. At the other end of the spectrum do you think that those women who engage in the professions and who are not subject to a career break are in fact at a disadvantage with respect to their male competitors and, if so, what do you think that that disadvantage is?

(*Dr Wright*) Could you perhaps repeat the last part, regarding if people do not take a break?

452. Yes, those that have the same sort of career progression as a man, are they at a disadvantage with respect to a man?

(*Dr Wright*) I will answer the first one perhaps, my Lord Chairman. I honestly do not know the answer to the question, my Lord Chairman, as to whether parents bring up their daughters with those kinds of expectation. Certainly I bring up my daughter to expect that she will engage in a career and a life that will fulfil her potential, and my main concern is that she should be able to make the choices that I feel she should be able to make, that is, the choice right across the spectrum of professions. I genuinely do not know the answer to the first one. I am not sure that we do know the answer. It is one about attitude and it will be very valuable if it is the case.

Chairman

453. Does it not argue for a positive scheme of re-entry?

(*Dr Wright*) It may well do so, my Lord Chairman. The position however is that the reason that I say that we do not know about that is that the outcome at the moment as I said is that we see steadily over many decades now, and it is not stopping, increasing staying on rates by girls at 16, increasing participation by young women in full time higher education at the age of 18 and, as we have been discussing this morning, we would expect and hope to see that that carries forward into careers. Already the work force comprises over 40 per cent women and women will comprise 46 per cent of the work force by 2000. Most of the new jobs that are created or taken up are expected to be taken up by women. The picture that we have of outcomes therefore as opposed to attitudes is that of steadily increasing participation by girls and women in education and employment at all stages of their career. Certainly, as

[Chairman *contd.*]

you say, many young women will still make the choice not to pursue this continuously at a particular point, whether it is 16 or 18 or 21 or 25, for one reason or another. That does argue for a breadth of provision for people to return to education later in life in their twenties, but what I should like also to address because you did mention this and I feel that it is particularly important is that if these attitudes are still there we need to address both the attitudes and the organisation obstacles that they attach to. Many organisations do now have very good maternity leave provision, child care arrangements of one kind or another, and perhaps more particularly in relation to the question provision for career break or for job share. Certainly as a university we have just adopted or are about to adopt a career break policy which would provide for women or indeed men with family responsibility to take one or more career breaks at that point in their lives. Now it is early days yet, but we—

Chairman] I think that that is the signal for us to go on because we are now over-running time and I know that Lord Howie wanted to ask a question.

Lord Howie of Troon] My Lord Chairman, I want to ask two questions but they are both very, very brief, you will be glad to know.

Chairman

454. It is the answers we are concerned about.

(*Dr Wright*) It is such an important area.

Lord Howie of Troon

455. I should like to go back to what you said about profiling as a means of finding suitability, and I was just wondering what it was—presumably it is some type of psychological arrangement, I imagine—and I am wondering if it is analogous to the tests that the army and the services use to determine what I think that they call officer quality, or is it something rather different, the kind of profiling which some academics use in order to identify certain kinds of criminals. It is the method that I am really interested in, because both of these have had somewhat mixed success and I am wondering what kind of profiling you really mean?

(*Dr Wright*) My Lord Chairman, what I was referring to was much more a profile of people's achievement and attainment and a way of looking at that not necessarily within the straitjacket of published papers, as we were saying earlier, but a little more broadly than that. However, it is true that one can also look at aptitude, but it is mainly attainment that I was thinking about.

456. My other question is very brief, my Lord Chairman. Do you consider that the barriers which women face in the academic world are any different from those which they face, say, in industry or is it just a particular example of a general case?

(*Dr Wright*) It is probably a particular example of a general case. However, it is also the case that at universities an academic career is liable to lag behind other sectors in this respect, and I should like very much for us to take the lead and to be the lead employers, but that is not the case at the moment and there are more women participating in other professions and in more senior roles than there are in academic life.

457. Do you think that it is slightly worse in academic life?

(*Dr Wright*) At the present time, yes, it is.

Chairman

458. Perhaps that is the cue for us to move on, and the natural thing seems to be that since Dr Joan Mason and Dr Lane are tackling some of the same problems perhaps we could have a brief session, Dr Lane, on how you are dealing with matters in Cambridge and anything related thereto?

(*Dr Lane*) My Lord Chairman, yes, thank you. We have in fact at Cambridge set up a Secretary General's working party. Now this is a rather informal working group which is more in the nature of a think tank than a policy making body. It has been put together by the Secretary General, as I say, and it includes in its membership four heads of house (two from women's colleges and two who are scientists) and three practising women scientists from the university, of which I am one. The role of this particular group is to identify issues of concern, problems and possible strategies relating to women within academic science regarding their scientific careers. We put forward proposals for action, policy change and development, which passed on to the appropriate university body. In short, we do not make policies ourselves because that is not the way that the university functions. We have, for example, my Lord Chairman, helped to initiate a research project at King's College Research Centre, which is part of Cambridge, and this particular scheme relates to ways to increase self-confidence on the part of women; we have been doing this for some time with graduates under a programme which has been called the Springboard programme. We now want to develop a comparable programme for undergraduates because we observed that lack of self-confidence is one of the major problems that our women undergraduates face.

459. May I ask you whether it is more marked in the mixed colleges than in the women's colleges, New Hall and Newnham?

(*Dr Lane*) We have debated this point long and hard, my Lord Chairman, and our conclusion is that that may well be the case. Certainly girls coming from single sex colleges seem to have more self-assurance. I myself teach at a college which was single sex but is now mixed, Girton College, and there you see the same problem of lack of self-confidence on the part of the girls. It may be related to the mixed environment although it is difficult to be sure. We are trying to carry out some research on that very point. We have published one preliminary report which we did in collaboration with the Wellcome Trust and we are now considering researching another one. There are various problems associated with doing that. One of the problems relates to the fact that when people lose self-confidence they "drop out" and if you want to try to follow those persons who have dropped out it is often hard to find them. I should mention that the context in which this committee in Cambridge is

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working is within that of the Opportunity 2000 initiative; we felt it was important to work closely with it and Cambridge joined that particular campaign in November of 1993 as, indeed, did Oxford. A number of other universities also belong. The major features which I think are important in this context are first that there is a monitoring procedure and that we collect data and statistics on appointments and promotion so that we can see where the women who have applied for jobs have gone, if they have not been appointed. It may be that women are not "putting in" due to a lack of confidence, and frequently we discover that this is the case, that women tend not to apply, but when they do put in on the whole they do rather well. The numbers of women applying for jobs in science are rather small and there are few women in posts. We looked into our recruitment and selection procedures at Cambridge because we were very concerned to have equal opportunities in place and we also looked at the gender balance of the various appointment committees.

460. You looked at—?

(*Dr Lane*) The gender balance, my Lord Chairman, of the various appointment committees at Cambridge.

461. You mean the proportion of men and women?

(*Dr Lane*) That is right, my Lord Chairman, because frequently at Cambridge it has been the case that there were selection committees lacking any women at all and it was felt that it was quite a daunting prospect for a women to walk into a room to be interviewed only by men; it was also felt that the views of that selection committee might be slightly biased against women if there was not a woman on the committee. We felt also, with respect to the issues that have already been raised that there should be special child care provisions for those women who did work for the university who had young children; the university has recently set up a crèche and this year for the first time it is instigating a holiday play scheme over the summer school holiday period.

462. If I may just interrupt you again, Dr Lane, in a collegiate college like Cambridge why is it necessary for the university to do it?

(*Dr Lane*) My Lord Chairman, it is a very sad comment that I have to make, but we have tried for years and we could not manage to persuade individual colleges to set up creches. In Cambridge the colleges that were originally male tend to have very few women in their fellowship and therefore there is no pressing need, as far as they can see, to establish creches.

463. In fact, Dr Lane, I must remind you that when I was Chairman of the University Grants Committee your college wanted to change its statutes and I warned it through the Privy Council that what would happen inevitably would be a decline in the number of women holding fellowships because it was an irreversible process. The college did not take note of that.

(*Dr Lane*) My Lord Chairman, you were right, and our college now has roughly 50 per cent men and 50 per cent women fellows; we actually deem that to be an admirable state of equality but we regret however the fact that many of the other colleges are not quite in that same state of equality, so you are quite right with regard to numbers of fellowships for women. The employment measures that the university has in place now include these so-called "family friendly" policies, permitting part time working and job sharing. Cambridge states that categorically in its procedures, but I have to say that very few people and particularly very few women have taken the option up, and our view is that perhaps women are afraid that they will be seen not to be serious about their research and their teaching if they actually go on a part time scheme. We are concerned with changes in attitude, and expectations on the part of our young women undergraduates and graduate students and that is why the Springboard programme that I have mentioned already has been put into place. We are also concerned about the methods of teaching and learning within the university and we are looking into our teaching styles and assessment criteria. We are particularly concerned with possible gender bias in assessment criteria. Some of you will know that there has been a committee set up at Cambridge to look into the History Faculty results which were strongly biased in favour of men, with very few women ever getting firsts—they all get 2.1s but no firsts—so we are hoping to be looking into whether or not there is bias within the assessment procedures of marking examinations which may lean towards a particular style of writing and presentation.

464. If I may just ask, are they not indicated by a number in the examination?

(*Dr Lane*) They are indeed, my Lord Chairman, that was the first change that was made; that made no difference to the results so the faculty went on to check assessment procedure.

465. So in that case you cannot obtain this gender bias?

(*Dr Lane*) Well, yes, one can extract that information, and since there was still this distinction it clearly had to mean that there was something in the way that the examinations were marked, on the assumption, of course, my Lord Chairman, that there was no difference in the intellectual capacity of men and of women! The university faculty working party considered whether there was a difference in the kinds of essays that were given first class marks. This they discovered was the case. The more flamboyant, "exciting" sort of essay seemed to be that which got a first class mark while a more careful consideration of data and the analysis of all sides of the case tended to get a 2.1 mark; it was felt that on the whole, the latter might be more the women's approach, but it was also considered that that approach was actually quite a useful one for doing research. In history, in particular, it emerges that you have to get a first class degree to get a British Academy grant nowadays, so that many young women who clearly had great ability in this field were not getting grants to do doctoral research because they only got second class marks.

466. You have I think got a characteristic Oxbridge syndrome there.

[Chairman *contd.*]

(*Dr Lane*) Perhaps, my Lord Chairman! Can I just go on to say that a number of points relating to this issue came up as a result of the Rising Tide, and you may remember, my Lord Chairman, that I chaired the working party for that.

467. Yes.

(*Dr Lane*) I want to say that a number of things emerged from that which relate to these points. One is that we are terribly pleased about the Development Unit at OST being set up—that result was very good—but we were very concerned that Government has not seen fit as yet to give the Unit a proper budget, and we are just hoping that it will be able to claim appropriate costings with time. We were also disappointed that no tax relief on child care was granted because we felt that that would have been very important for women all across the board in this country. We also regretted that the issue of education was not adequately addressed in the Government's response and this relates again to a point that was made earlier regarding decisions by girls in schools. We felt that to broaden the 'A' level syllabus would have been a very important development in terms of allowing more young people, including girls, to go on to take science, and I know that this is a point that has been raised by a number of organisations, and we felt very strongly too that this would have been extremely helpful. We also within the university at Cambridge, and again by extrapolation within the Development Unit at OST, very much hoped that what we might persuade people to do in universities in particular, was to look, not just at published work in assessing job applications but also the way that they had contributed in other fashions to their department such as by their teaching, by their mentoring, by their departmental committee work and so on. We are trying to press for that to be taken into account when people are being considered for promotion in universities. We also felt, as does the Royal Society, that one should take, not chronological age, but *academic* age into consideration. This would be helpful for women because if they took maternity leave for several years then that loss of time would be disregarded. This loss of time, together with their lack of published work relative to men normally means that women are at a disadvantage if age and publications are taken to be the "all important" factor. Wellcome and the Royal Society have both put admirable policies of this kind into place and we are hoping that those sorts of adjustments will serve as models for other universities and for other employers.

468. May I just ask you in relation to what you are saying in order to get it absolutely clear as far as your views developing in this committee at Cambridge is concerned that this is not yet adopted by the university?

(*Dr Lane*) That is correct for many other institutions; at Cambridge, we do already take other contributions into account, my Lord Chairman. There is then a further point that I should like to put which is that a scheme has just now been adopted by Oxford which has apparently been in place for some time in some other universities, including Imperial College. This is a scheme of "delinking" university posts from named positions in the hierarchy. Whereas previously you had to have a university lectureship, readership, professorship, to use such titles, it is now possible at Oxford, and at a few other places, to be paid by some other body such as a research council, or by salary through some other contract work that you might have, be it short or long term, and still achieve the rank of lecturer, reader or professor. The title might be "honorary" professor or "honorary" reader or "honorary professorial fellow" or some other term. We see this as being a particularly good scheme for women, as well as for men, on short term or different kinds of contracts because it does mean that they can be given some kind of status. At the current time if you do not have an established university position in most universities, you lack any status.—

469. But why is this so? For many years Cambridge has had the posts of Assistant in Research and Assistant Director of Research.

(*Dr Lane*) Yes, but, of course, my Lord Chairman, those were never deemed to be a particularly senior positions. To be able to move from assistant director of research to some other title such as, for example, associate reader or professorial fellow would actually be a very different sort of category.

470. When I was in Cambridge I noted in the Department of Colloid science two of the three assistant directors of research in that laboratory were Fellows of the Royal Society. Has the situation changed?

(*Dr Lane*) Well, interestingly enough, my Lord Chairman, in my department there is a Fellow of the Royal Society whose long term contract lapsed. As he was left without any post, he was made an honorary reader, but that was a rather unusual situation and it has not been followed in general. Most persons elected to Fellowships of the Royal Society are now given *ad hominem* chairs; they are a special category and very few women are put up, or elected, to the Royal Society.

471. But there is no reason why people should not have a university title if their full time research is of some kind that the university can determine which has parity of esteem, to use an overworked word, and parity of opportunity?

(*Dr Lane*) I absolutely agree, my Lord Chairman, but it certainly has not hitherto been the case in Cambridge and it has not been the case in Oxford, which is why they have just changed their rules and their statutes which I believe is a rather helpful development. If I may come back to Baroness Platt's point about a code of practice, which I think was admirable, I should like to say that when the Rising Tide was being discussed before the Development Unit was set up, one of the things that we, the Working Party, thought would be very helpful would be if this kind of code of practice could be in place among industrial employers and universities. If universities or employers who had taken on board that code of practice could be designated as such by some sort of "stamp of approval", young people wishing to go to whatever university or whatever employer could immediately see whether that employer or that university had in place this particular code of practice. This was something that

[Chairman *contd.*]

we discussed but did not actually include in our final document; it was something that we hoped that the Development Unit might consider. What I do feel, my Lord Chairman, is that there are a number of strategies in industry which would be helpful for universities to adopt; the reason I think that industry has put them in place is because in industry what really matters is the "bottom line". If they can put something in place which is to the economic advantage of the company by reaping financial benefits they will do so. In universities it seems to me that this argument does not hold force in the same way. Therefore one should look at what best practice has been occurring in UK industry and hope that universities will do the same. Nuclear Electric has put forward workshops for women on their personal development which encourages them to have more self-confidence; Smith and Nephew have an objective assessment centre which is very important in terms of the initial recruitment and retention of staff. Unilever provides a flexible working environment and has tried very hard to have a less male dominated culture which they say leads to greater success for women in their company. Texaco too has "awareness" training and "dignity at work" policies in place.

472. If you wish, Dr Lane, you can submit this information in writing in order to save time today.

(*Dr Lane*) Very well, my Lord Chairman. There are several other companies which have comparable packages including child care initiatives, child care vouchers and work place nurseries and it seems to me that we in universities might take account of some of those policies in industry and put them in place within the university scheme. With regard to the psychometrics and the profiling which Dr Wright mentioned, I have observed that this does take place in a number of establishments and I have noticed that in some cases it is in fact aptitudes which are being measured, which Lord Howie may be interested to hear, whereby an assessment is made by the individual themselves as to their aptitude. From that a profile is drawn up and then, by comparison with the profiles of other persons who have been successful in the particular field in which one is looking for excellence one discovers whether or not the individual in question would be likely to be comparably good. It has apparently been succeeding rather well in recruitment in industry. There are a number of other little points that I would like to bring up but those are the major points that I want to make apart from mentioning that the Open University returners' scheme, which I think is very important, needs more money to fund women coming back to retrain if they have taken a career break. The unfortunate aspect of the university's returners' scheme is that it now is not being funded centrally but by local TECs and as a result it is not functioning properly.

473. By TECs you mean technical education councils?

(*Dr Lane*) Yes, my Lord Chairman, TECs. I know that Baroness Platt knows a great deal about this problem and is working very hard to improve the position. I have here a paper which I would like to submit to the Committee on the current position stating why something needs to be done for funding of that particular venture, which is very important.

Chairman] Thank you very much, Dr Lane.

Lord Craig of Radley

474. You said that you have identified a number of ways in which things could be improved, which is very helpful, but I wondered which ones do you think are the most important to be concentrated upon because you have given us a very wide remit. If it was our responsibility to try to improve the situation we would be kept busy on your remit for quite some time, so on the basis that not all of them can be tackled at the same time I wondered which were the ones that you felt with your experience are the most important?

(*Dr Lane*) I think that the establishment of "family friendly" policies is terribly important because it gives people the possibility of job sharing or taking time off for maternity leave or having the flexibility to fit in with their children's life style, given that most women tend to marry and have children. I do think, however, and this is something that I did not really mention before, that something else which is important is mentoring.

Chairman

475. That is what?

(*Dr Lane*) "Mentoring" is career advising really, having somebody in the establishment who can give the individual advice about what their career development might best be, what the next step should be in their career development.

476. A career adviser in plain English?

(*Dr Lane*) Yes, it is measuring in general terms—

Baroness Platt of Writtle] If I may say so, my Lord Chairman, it is rather more than that. It has also been an example of the role model.

Chairman] So it has to be somebody of your own gender?

Baroness Platt of Writtle] No, not necessarily.

Chairman] Being a role model, you said, in this case?

Baroness Platt of Writtle] It is very important for a senior member of staff to be considering how a career can be developed and advising the younger member of staff.

Chairman] But that is just good departmental management.

Baroness Platt of Writtle] I agree with you, my Lord Chairman, but it does not always happen.

Lord Craig of Radley

477. It is called leadership!

(*Dr Lane*) Within some colleges in Oxbridge there are what they call big sister or brother, somebody in the year above who advises you, but mentoring is much more than that. Role models for girls need not necessarily be a woman although frequently they are, but in fact studies that we have made show that it does not have to be some one of the same sex as long as it is somebody who encourages you and gives you

[Lord Craig of Radley *contd.*]

an opportunity to think about your career development. It is somebody who actually gives you the encouragement to believe in yourself.

Chairman

478. It is a skilled counsellor, is it?

(*Dr Lane*) Yes, that is right, my Lord Chairman, and many companies have put these people into place and some enlightened universities have to. It is something that we are thinking of doing at Cambridge because of our anxiety about our students. In answer to Lord Craig's comment, this issue of giving people some sort of status is terribly important. If you continually feel that you are the assistant research person down in the lowlier ranks your comments never seem to be important and self-confidence is lost. I think that to have some sort of status and some sort of position in the university, even if it is honorary and does not include a salary, could really be very helpful to women scientists.

Lord Craig of Radley

479. There is a very strong implied criticism in what you are saying of the more senior levels within the organisations or the universities, that they are not effectively performing what I would deem to be an important part of their responsibility?

(*Dr Lane*) But of course what you have to bear in mind is that the culture in which we operate is very much traditionally male, as I am sure that you would recognise. Therefore in a way women do not fit into this culture quite as easily as men. One of the problems that I think women encounter is the fact that this so-called networking that takes place often does so in men's clubs, over lunch, at the bar, at the golf club etc, where women are essentially excluded. Probably they are home looking after the children so that they do not have an opportunity for this informal networking which would give them the opportunity to know what was happening, make contacts and move upwards. I agree that it is very important that a senior person should take account of these things. In instances where the senior member of the team has noticed the problem and has done something about it, it is amazing what has happened. Nuclear Electric is a very good example. However, I think that it does require people in very senior positions to be aware of it and although I think that increasingly they *are* becoming aware, it is taking time because of the our tradition of the male-oriented scientific culture.

Chairman] Lord Howie, I think that we have time for your question.

Lord Howie of Troon

480. I have been invited as a guest to one or two of these female networking functions—absolutely terrifying!

(*Dr Lane*) May I ask why? Because the women were so terribly clever?

481. Absolutely, they are all very tall and have big shoulders. However, turning away from Cambridge for just a moment, you did mention I think the narrowness of the 'A' levels and I think that you have touched upon the relative successes of girls' single sex schools. But there is a part of the country, of course, where they do not have 'A' levels, they have a wider thing, and where also mixed sex schools are rather more the norm than less. My question is this: is there any difference in the output of female scientists as between Scotland and England or is it the same?

(*Dr Lane*) This is a very good point, my Lord Chairman, and I believe that the "highers" in Scotland, which have a broader syllabus than 'A' level, just like the baccalaureate in France, are the systems that we should be hoping to emulate. It is difficult to get your hands on hard rather than anecdotal data to prove that Scotland's output is better in terms of numbers although we have tried to get such data for our report because the Working Party felt so strongly that England should try to emulate the Scottish situation.

Chairman

482. If I may draw your attention to something that was published in 1968, you will find the comparison though not in terms of gender difference but in terms of numbers of people going on from school into science.

(*Dr Lane*) Right. I was just going to say, if I may, my Lord Chairman, regarding this problem of single sex versus mixed schools, it is difficult for one to be sure why girls do better in the former, but there are data which show that teachers in a mixed sex classroom pay more attention to boys than to girls, possibly because the boys are more lively and difficult to contain.

Lord Howie of Troon

483. My recollection of our science teacher is that he was rather more interested in the girls!

(*Dr Lane*) The data suggest that although teachers do not even recognise it and will not admit it, nevertheless that is what in terms of number of minutes spent is the case. Hence in some schools they are instigating single sex classes for subjects like physics and maths although of course one would not wish to change back to single sex schools because that clearly would be retrogressive.

Chairman

484. But does that actually work?

(*Dr Lane*) Yes.

485. You have data on this, have you?

(*Dr Lane*) Well, we do not have hard data on the single sex classes that have been set up, but what we do have hard data on is the number of minutes that are given to the boys rather than girls by the teacher in a mixed sex class situation.

486. The number of—?

(*Dr Lane*) The number of minutes that are given to the boys by the teacher attention-wise rather than to the girls. Therefore by extrapolation if you have single sex girls classes teachers can only pay attention

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to the girls and what is more there is no competition for recognition by the opposite sex in the single sex context.

Lord Howie of Troon

487. But they might give some of the girls more attention than the others. You have not measured that, have you?

(*Dr Lane*) That is true.

488. Have you measured it?

(*Dr Lane*) No, we have not. It could be an issue of personality.

Lord Howie of Troon] The clever ones.

Baroness Platt of Writtle

489. You talked about the need for family friendly policies and there is no doubt about it, that that is the key thing because maybe in years gone by young women were not encouraged to have careers, but I think that more and more they are. However, there is the fairy tale thing, they got married and they lived happily ever after, which we all know is not the case. They are going to have a new life which may develop in all sorts of different ways, but when the children come it is very often going to increase the responsibility of the women, and when they are professional women they will probably be in their thirties just at the time when young men might be taking a great boost in their career. Now they are likely to marry each other if they are both working in universities, and a number of universities have set up very good family friendly policies, but there is the question of dual careers—one or the other succeeds. Sometimes they take turns in deciding whose career is to develop next, but the other one inevitably takes second best. I wonder whether you have any experience or anything that you have talked about in your committee in regard to that?

(*Dr Lane*) My Lord Chairman, we did consider this as being a very important issue. We saw that up until now nearly always the career of the man has taken precedence; we assumed, on reflection, that the reason for that must be that on the whole his job tended to be a better paying job and since the family had to survive, in terms of sheer economics they had to allow the one who was making more money have the better options. We should like to think actually that with the passage of time that is going gradually to change. Indeed, we are told that some young couples, both for example doing a PhD, when looking for a post doctorate position, might take whichever one got a job offer first. What is interesting here, my Lord Chairman, is that I have subsequently heard that although both may be looking for a position when the full time job comes up it tends to be the boy who gets that which leaves the women in the position of being left behind or in a lesser job. I think that it is very difficult to find an answer to this except to say that the tax relief on child care costs that we discussed before, which have not yet been achieved, would be helpful because it would mean that then the family would be able to afford to have a child carer so that both parents could hopefully continue with their careers uninterrupted. I actually did take a couple of months off with each of my children, but not longer than that, because I was worried that I would lose my job, which indeed I would have done, had I taken a longer break. But it did mean that there were very difficult times because in those days there were no crèches set up and one had to employ child carers oneself, which was extremely expensive, so most of the woman's salary tended to go on the care of the children. I think that it is a problem and it will have to be worked out. It is difficult to see how you can actually do anything other than try to set up flexible policies which help to enable the woman to continue to work unless by sheer luck she gets the job that pays the better salary, so that the male partner takes on the children!

Chairman

490. Dr Mason, we now come to you, if we may. Thank you very much for sending us both the reprint of the article and also the original and your other deposition here. Is there anything that you would like to say in general about it?

(*Dr Mason*) My Lord Chairman, may I say that I strongly support what my friends have been saying so I will try to address my remarks to subjects that have not yet been discussed very seriously. On the cultural problem, I see this as a circular process. The man's career is the more important since he is likely to earn more, so the woman looks after the home and her career takes second place, and the man earns more. I find the discussions in the American literature very interesting. I discovered that I had been a "trailing spouse" for I suppose 14 years and this is the sort of thing that happens when couples move to further the career of one partner and not the other. I can say at this point, my Lord Chairman, that I do see some improvement in my sons' attitude—I have three sons—to their wives and their children so I think that progress, very gentle progress, is being made. My submission was much concerned with documentation, and—this is very important—we need both documentation and monitoring. I have included these graphs, charts, of proportions of women in various sciences and at the various stages of a career. The importance of documentation and monitoring was insufficiently recognised in the Government's Response to The Rising Tide. I do not want to use the word disappointment about The Rising Tide because overall we are very pleased to see this public recognition of the woman problem in science. On the other we should have liked to see help for women returners, we should have liked to see more proposals for child care, nursery provision and tax relief. There is a double taxation element when families pay for child care. Should should stress also that most families now reckon that they need two incomes. So if a girl or woman is not careful about how she is going to earn her money in later life, and, as so many do, thinks more seriously about finding a partner than establishing a career, when she finds herself looking round for ways of earning money she may not be well equipped for this. Now I spent a couple of decades with the Open University (I was on the central staff). I am particularly impressed by the advantages for women in being able to study at home

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in their own time and at the appropriate stage of their career. We are all shocked at the way that this very successful Open University Returners' Scheme in effect has collapsed because of the withdrawal of central funding.

491. For what reason did you say that it collapsed?
(*Dr Mason*) The scheme began in 1982 and was very successful as a retraining programme for qualified experienced women who had left employment for family reasons. It was funded by the Manpower Services Commission which then became the Training Agency. Three or four years ago the central funding through those agencies was devolved to the TECs, the Training and Enterprise Councils. There are about 100 of them. They are called LECs in Scotland and something else in Northern Ireland. So the Senior Counsellor, Dr Ailsa Swarbrick, who was running this scheme on half a day a week, I believe, tried applying to all the TECs for funding for the returners' scheme because the central funding was devolved. This was very hard work and quite inappropriate for a national scheme.

492. What was the money to be used for, the preparation of courses?
(*Dr Mason*) No, I should have explained the Returners' Scheme. This was called Women In Technology, the WIT scheme, but women could read science, engineering, mathematics etc. A woman who had spent time at home because of family commitments could qualify for this scheme. It began with a counselling weekend at the University of Loughborough, when the women came together—about 100 a year, I think it was. They needed counselling and job advice. The scheme included the counselling, and payment of the Open University course fees and summer school fees, because the last thing that a mother of a young family is going to spend money on is her own education. Included in the range of Open University courses the women could choose from were very broadly, science, engineering, technology, management courses as well. This excellent scheme also included job placements. scheme.

493. So it is a free service but they got nothing for their own personal expenses?
(*Dr Mason*) Well, they lived at home, you see.

494. So they just attended these courses?
(*Dr Mason*) They took Open University courses, distance learning courses.

495. But in the early stages they received the counselling that you said and help and that was also paid for?
(*Dr Mason*) When you are taken on the scheme the year begins with a counselling weekend at Loughborough where you meet the other people on the scheme, and this mutual support is very important too. It is very like the Springboard enterprise. It involves the networking, the mentoring and so on which we find so important for women. They chose their own mix and match of courses as Open University students do and it was very open, the process, in the sense of women suiting themselves as to how they proceeded, the pace and choice of subjects. It was an excellent scheme.

496. And their fees were paid on these courses?
(*Dr Mason*) The fees were paid, yes, by the scheme. It was a very cost-effective scheme because the women were living at home and continuing to look after their young families. I do not know whether Baroness Platt wants to say something more about it.

Baroness Platt of Writtle

497. On another occasion I will, yes.
(*Dr Mason*) I personally am horrified that the thing has just sunk, collapsed. A few of the TECs were willing to support it, and the scheme has limped on for a year or two after the central funding was withdrawn, but this process will soon be over.

498. This year it is still going, supported by just one TEC.
(*Dr Mason*) The scheme is going this year, but only in Calderdale. The economics of scale are lost.

Chairman

499. Since there are other subjects that we need to ask may I just ask you a simple question? Are you saying that it was a good scheme and that the lack of it really creates a gap which should be filled?
(*Dr Mason*) Yes, profoundly, my Lord Chairman.

Lord Craig of Radley

500. My Lord Chairman, I understand very clearly the cost effective nature of the scheme because people are living at home. I think that the question might also be asked, how many of those students when they had graduated then went into some job, a scientifically related appointment?
(*Dr Mason*) This scheme was monitored exhaustively. The people who were running it were for ever writing reports. I am sorry I could not quote the detail.

Chairman

501. Could you pick out the information required to answer Lord Craig's question? Can you discover from your extensive records the information and let us have it?
(*Dr Mason*) I can, yes, my Lord Chairman, we can do it between us.

Lord Craig of Radley

502. It is another measure of effectiveness.
(*Dr Mason*) Oh, yes, effectiveness of the WIT scheme.

Chairman

503. Would you please send it to the clerk?
(*Dr Mason*) Yes, my Lord Chairman.

504. Thank you.
(*Dr Mason*) My Lord Chairman, I thought that I should say something here about an idea that I am trying to develop in my head. It is the Department of

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Employment, that funds training schemes, which has now devolved the central funding to the regions. Now I did ask somebody in the Department of Employment why they kept changing like this, and she said that it is to keep control—I do not know whether I want that reported.

505. It is in!

(*Dr Mason*) Something that I do not understand is why if the Open University is an institution of higher education it should rely only on the Department of Employment for WIT funding; why cannot this funding, which is not enormous, in some way come out of the Higher Education budgets. In fact, I have sent a message through to one or two people in the Open University saying, can this be explored through the Higher Education Funding Councils, perhaps they can be persuaded that this is a suitable case for action. That is the Open University scheme. May I now perhaps say a few words about the Daphne Jackson scheme.

506. Perhaps you could be brief because there is another major issue that we need to tackle.

(*Dr Mason*) The Daphne Jackson scheme relied on industrial funding (we have an authority seated behind us here) early on. Daphne Jackson wrote to industrial firms, and I wrote to a few, to help. In recent years it has developed into something much broader. Money is being put together from research councils, from universities, Wellcome and so on. This is all in Betty Johnson's submissions so I will not go into it. Equally important with the Open University returners' scheme, which is on one level of people retraining or updating, is the Daphne Jackson scheme, on a rather different level. It is taking women who are capable and wishing to return into laboratories with research and retraining support. This is really now snowballing to some degree. The Royal Society and other institutions are taking on some responsibility for Daphne Jackson fellowships. What I would point out is that when you actually count them up—Wellcome has just instituted two returners' fellowships of this kind, which are very, very welcome—there are not enough. It is really a drop in the bucket. The schemes are admirable and we need more of them. I have made some notes to address the questions that you asked us, my Lord Chairman. You asked about our disappointments.

507. I have gone through the list of questions. I think the only point that I noticed that has not been met is the point in question number seven, the Rising Tide report and the Government's response. Perhaps you could all address that. Are you disappointed with it?

(*Dr Mason*) You asked me about Springboard.

508. Yes, indeed.

(*Dr Mason*) Springboard was developed inside the BBC. The BBC has been anxious for many years, that its decision making and its productions should properly take account of women's as well as men's needs. Now Cambridge has embraced the system. What happens is that a number of young women graduate students and assistant staff—that includes technicians and administrative people—can apply, and if they are taken on as Springboarders then they do a three-months "course". They get *this* Work Book (you see), which people might be interested in. It is effectively for confidence building, which is a major problem for women. The appointments boards are always saying, "We can't appoint women, women don't apply", and I see this in chemistry, that you get one women applying and 70 men—a fearsome ratio. Springboard encourages them to apply. Going through the work book, answering the questions, the women examine their own selves, their ideas about their careers, and their relationship with other people. They have three days (one at the beginning of each of the three months) in which they have sessions with a trainer, then retire into groups and discuss aspects of the work book. I myself am what is called a helper. Springboard involves mentoring as well—and it is a useful word, my Lord Chairman! This mentoring and networking, people often ask what they mean. Women find that the men have their networks and mentoring also—and I do not know whether this ought to go on the record as well—it somehow includes patronage. We all know that men have their patrons, that a scientist may have a senior scientist, who knows that he is good and looks after him, puts him up for the Royal Society and that sort of thing. Part of the purpose of mentoring is for women to help other women, if the system is not helping them enough. I am not saying that men do not propose women for the Royal Society, so to speak; what I am saying is that too few women are proposed—but let us leave the Royal Society out of it.

509. I am afraid that I am going to have to press you, Dr Mason, because I should like to get your views, and I am sure that the Committee would, on this proposal which came from Government of the Master of Research which is down on your paper at the end, and we should like to know whether that proposal, which has now been taken up by the research councils to develop schemes, you see any advantages in for women or any disadvantages. This is open to all of you for anyone to respond.

(*Dr Mason*) I think that the MRes is welcome so long as it genuinely increases the range of opportunities. If it is used as an excuse to cut PhDs it is not increasing the totality of opportunities. It is not normally appropriate on its own for an academic career. On the other hand, it could be very useful for training in emerging fields. I heard the interesting suggestion that our advances in understanding may reduce the volume of course work in existing fields, but new techniques and new fields are constantly emerging. I can see an MRes in biotechnology or DNA sequencing for example. Another argument for the MRes—perhaps I am being a devil's advocate—is that if we move beyond our present pattern of specialised 'A' levels, following the Scottish example or the baccalaureate, then this shifts more of the course work to the higher levels.

510. Well, does it? I really must ask the question here because in natural science tripos at Cambridge it has always been assumed over four subjects which you could have in part I that some must be ab initio because schools did not provide for that pre 'A' level.

(*Dr Mason*) Well, if anything that I took was ab initio it did not seem it at the time, and what I see now is not. It may start ab initio, then it leaps.

Baroness Platt of Writtle

511. My Lord Chairman, may I ask a question about the MRes as to whether it would be a good idea to have a part time version, which I think the Daphne Jackson fellowship suggested?

(*Dr Mason*) Why not, yes.

512. So that it could form a way of retraining for women who return. On the other hand I equally know that if you are going to be part time you are going to have problems over grants. I wonder whether there is any view about that?

(*Dr Mason*) I do have some more points supporting the MRes. One is that if it is a question of an MRes as against more course work, many students put much more of themselves into their very own project, than into their course work, and this is often truer of women than men. The examination problem, with men getting more First Class degrees than women, over most of this country and Scotland as well, is not found in the Open University, where half of the students' assessment is by course work and it does not happen in America where a high proportion of assessment is by course work. The all-or-nothing type of examination does seem to disadvantage women. Now I would particularly like to speak to your question number eight.

Chairman

513. We are dealing with MRes at the moment, and I must ask your colleagues now whether they want to say anything.

(*Dr Mason*) Yes, I am sorry.

(*Dr Lane*) If I may, my Lord Chairman, I can see that the one year might, as Baroness Platt suggests, be a good thing for a woman trying to come back to science. I think that the problem with it generally is that one year really is not long enough to be trained in research as we know it and most of us who have thought about it would have said that it would have to be a preliminary year prior to the PhD.

514. Is that because Cambridge offer little opportunity for undergraduate projects?

(*Dr Lane*) No, that is not the case, my Lord Chairman. In your final year, your third year as an undergraduate, nearly every science subject at Cambridge now gives you an opportunity to do one or two research projects. In my department, zoology, it is two short or one long project.

515. So Cambridge is catching up?

(*Dr Lane*) Yes, it has "caught up" and leads the league tables! Now it really will depend upon the nature of the practical experience that students are given in the MRes, and what they plan to go on with, as to whether the degree would be of any use. I think that one would hate to think that this one year research degree is going to take over and would preclude students from doing the three year PhD, (a) for science in general and (b) for our international competitiveness, because we could not possibly hold our heads up in other countries, particularly in the United States, if we only had our students doing one year research degrees they would not be sufficiently knowledgeable or skilled.

516. This presumes some view about the PhD degree as having an international currency because it has certain qualities. What are those qualities?

(*Dr Lane*) In the United States, my Lord Chairman, they do a five year PhD because the first two years are spent doing course work to get them into the position that our graduates are when they finish their bachelor's degree.

517. Having had a considerable number of American post docs myself I would have said that they lacked quite a lot, not least being their ability to write.

(*Dr Lane*) I would agree on that point actually, although the ones from the best universities in the United States in fact are extremely good, as one would have imagined would be the case.

518. But then no university can ruin first class people, can it?

(*Dr Lane*) I agree, but I would say that in general our view would have been that at the end of the PhD UK and US students are more or less equal but that at the end of the first year undergraduate course the United Kingdom students are head and shoulders above the US and the US needs to do those extra years of coursework for the PhD. Having said that, my Lord Chairman, I should tell you that a number of my colleagues tell me that they now think that a four year PhD might be an admirable thing for the United Kingdom because they can see that three years may not in itself be long enough.

519. Do they realise that that inevitably means three quarters of the entrants?

(*Dr Lane*) Exactly, and an additional cost to Government.

520. Not the additional cost because Government of any party will not have it at the moment, which is why I said that it means three quarters of the entrants.

(*Dr Lane*) We want to maintain the number of students which is why currently the departments in my university at least are pressing people to finish in the set three years, because if they do not departments do not get grants for other students.

521. Dr Wright?

(*Dr Wright*) Thank you, my Lord Chairman. I should like to answer this in relation to the issue of women in science, if I may, and just to say that I regard it as very important indeed if this initiative is piloted and if it is extended that we are able to monitor its impact on the uptake by women of postgraduate qualifications. As I said earlier on this morning, women now are participating more in postgraduate taught programmes and a little more in PhDs but that is quite a gradual process and we need to look carefully among other things to monitor whether the MRes would have a positive or a negative impact on that, and in my view it could work either way. It could be attractive to women to take a shorter qualification so not having to embark on a three year programme, for example, so it might prove more attractive at entry. But on the other hand if it is then perceived that a PhD needs to follow that so that actually the apprenticeship is lengthened, then it may actually have a higher non-completion rate in the end, so in fact it might attract more women into a potential scientific career in research or in academia,

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but it might actually act as a deterrent in the long term, and I do think that it is important to monitor it.

522. Have representations been made to those who are organising these pilot schemes, the research councils I mean, to watch out for the effects of it as far as gender is concerned?

(*Dr Wright*) I am not sure that they have been made very strongly, my Lord Chairman.

523. Perhaps it should be done?

(*Dr Wright*) I think that it should, yes.

524. Dr Lane?

(*Dr Lane*) My Lord Chairman, may I make another point to support this monitoring issue which I think is very important. As it happens the data for 1993-94 show that in fact 50 per cent—actually, it is 49 per cent, close to 50 per cent—of people doing PhDs are women in the biological sciences. However, when it comes to chemistry and physics it is only 30 per cent or 25 per cent, 14 per cent in information technology and even less in engineering.

525. But rising in all?

(*Dr Lane*) Well, actually, it has not risen at all in the last three years and I have figures with me that show that the figures have remained almost constant over the last three years, 1992, 1993, 1994.

526. Are you speaking of the total number or the proportion?

(*Dr Lane*) I am talking about proportion, my Lord Chairman, the proportion of women, so that it is relative to the overall numbers, of course.

527. The numbers are rising?

(*Dr Lane*) Yes, the numbers are rising slightly, but not the proportion of women. With regard to the monitoring it is a point that has been alluded to earlier and I think that it is extraordinarily important. In this context and in the other context of women in general, when we wrote The Rising Tide report we said that monitoring was imperative and we actually suggested that the Government should set a quota or a target of 25 per cent of women in senior science positions by the year 2000. That was not accepted by the Government in their response because they felt that they did not know sufficiently clearly what the current bottom line was, that is, how many women actually currently hold senior positions, because the available data tend to reflect women in general rather than women in science in particular. One of the things that we felt was important which I would like just to draw to your attention, my Lord Chairman, is the importance of media attention to women; perhaps one of the ways of achieving that is via the placing of women on more senior committees and public appointments whereby there would be a higher visibility in public of women being seen to be active in senior office. Such women would be the kind of role model that we were referring to earlier, in the way of indicating that women were actually doing rather well in science. I think that that monitoring could help very much by looking at the numbers of women (currently very few) on those sorts of committees. I think that it would be quite important along those lines to have a database, which was suggested by the report we produced. The Development Unit is actually hoping to set this up so that we will have the names and activities of women in science to which these appointment committees could go. That database would have the appropriate women with their credentials so that they could then be appointed. Hitherto one of the problems has been that Committees have always asked, where are these women that we should appoint? We don't know where they are! With the public appointments unit it seems as though, although womens' names go into that particular set up, they then disappear, because not many women are appointed. I would just like to add that there are a number of academic developments with regard to the media issue which—

528. This is really getting away from MRes, which is what we are on.

(*Dr Lane*) Very well, I will stop now.

Chairman] I must ask my colleagues now whether they have any questions which they would like to ask of you.

Lord Howie of Troon

529. Yes, I would like to ask one question, if I may, my Lord Chairman, just a very brief one. Dr Mason, in your submission, paragraph 7.1, you have a look at the United States and you refer to "particular provision for women in minorities", which sounds to me a little bit like positive discrimination. Would you fancy a bit of positive discrimination in favour of women?

(*Dr Mason*) Thank you for asking me because I was hoping to answer that question. Positive discrimination in employment in hiring is illegal under the Sex Discrimination Act. On the other hand positive discrimination in training is respectable—that is what we are talking about in the Returners' schemes and the WIT scheme. Now I would like to say something about the American and the Canadian situation. The American legislation is stronger than ours and so their example is not quite as appropriate as the Canadian one, but the fact remains that the Working Party for the Rising Tide was set up just a year or two ago and in America they set up a congressional committee on equal opportunities in science and technology in 1980—the CEOST committee—well ahead of us. They passed the Science and Technology (Equal Opportunities) Act in 1980 in America requiring the National Science Foundation to promote the full use of human resources to increase substantially the contribution and advancement of women and minorities and to report to Congress biennially. Now that is the monitoring function. I have with me the biennial report to Congress for the year 1992. That is the kind of provision that we need. The National Science Foundation in America has a directorate for education and human resources, to promote the interests of women and minorities and they have put on some very good programmes. They have Visiting Professorships for women, also research planning grants, and career advancement awards for women. They have a large number of activities for women and girls in science, engineering and mathematics. A lot of this happens in Canada as well. I use E-mail and I subscribe to several E-mail discussion lists.

[Lord Howie of Troon *contd.*]

There is one called Wisenet, for example, which originates in America, and there is one called Daphnet, which Betty Jackson has set up in this country named after Betty Jackson so information on these activities goes round the Internet, and we are well informed on the activities.

530. I am sorry to interrupt, but let us get away from the information. As I understand it, positive discrimination in the United States is legal but it is under a little bit of a cloud at the moment, and I am really wondering whether you would like to see positive discrimination legalised in this country. That is really what I am after.

(*Dr Mason*) Oh, no. I think that what we need is a greater understanding of how our institutions as they exist discriminate against women, institutions that date from a period when the university or the profession was all masculine. I think that we need greater understanding and all these other measures that we have been talking about, not positive discrimination in favour of women.

Chairman

531. I think that we have already overrun our time. If none of my colleagues wish to ask anything further I therefore must draw it to a conclusion, but there are two things that I should like to say. First of all I hope that we have elicited from you all the things that you would like to bring to our attention. Secondly, if we have not, it is perfectly open to you to submit anything in writing to us that you wish. It would be helpful to us, Dr Mason, if you could in fact give us the references to the National Science Foundation which you have been referring to because some of us are in fact visiting the United States to discover first hand what their problems are in this particular field, not just the women, but the whole business of research careers generally. May I ask whether there are any burning points that you want to bring to our attention now?

(*Dr Mason*) Thank you for having us, my Lord Chairman.

Chairman] Thank you very much for coming, we are most grateful.

Supplementary Evidence from Dr Joan Mason

A Review of Women who have taken part in the Women in Technology scheme (from a note by Ailsa Swarbrick, 1993)

Since 1982 over 800 women have taken part in the Women in Technology scheme (WIT), and the Women Returners Scheme (WRS), which replaced it in 1993, with a portfolio of schemes in environmental, computing and industrial production fields (at the request of the Department of Employment).

The WIT-WRS scheme was provided by the Open University and funded by the Department of Employment to enable women at home for family or other reasons to update their expertise by studying OU courses in science, technology or computing, in preparation for a return to employment.

Of crucial importance, for women with no earned income of their own, were the bursaries covering the course and residential school fees and related expenses. Equally important has been the all-women project office, providing telephone advice and counselling. All students attended a residential weekend at Loughborough University to prepare them for OU study and to help them to revalue their abilities. The counsellors monitored progress, encouraged networking through a newsletter, and offered support, career counselling,vocational guidance, and a work placement.

The results speak for themselves. The surveys show that despite being out of employment for up to 14 years, over 80 per cent of the women responding obtained relevant employment within two years of completing their course, until the recession in 1991. They returned to jobs in civil, chemical, electrical, microwave, aeronautical and transport engineering; the oil and gas industries; environmental control and monitoring; water authorities; telecommunications; in all branches of computing and information technology; in research and development; and in the education and training sector.

This has been a national project, using the OU's distance learning system and its economies of scale. Experience has now shown that with the devolution of the national training budget to over 90 TECs and LECs, the WIT-WRS scheme is no longer viable.

TUESDAY 7 MARCH 1995

Present:

Craig of Radley, L.	Phillips of Ellesmere, L.
Dainton, L. (Chairman)	Renwick, L.
Haskel, L.	
Hilton of Eggardon, B.	Platt of Writtle, B.

Memorandum by the Biotechnology and Biological Sciences Research Council

EXECUTIVE SUMMARY

— The Council shares the widespread concern in the scientific community, that the expansion of short-term contract research posts, unmatched by longer-term career opportunities in research and higher education, is creating a negative perception of careers in science.

— Research funders and the employers of researchers benefit from the flexibility of contract research posts; mobility between successive contracts transfers experience between laboratories, introduces "new blood" and can stimulate personal intellectual development.

— These benefits are counterbalanced by the costs and insecurity associated with high turnover, and by the danger that an insecure casualised research career structure will be increasingly unattractive to young people of the highest quality.

— There is likely to be little demand-side change affecting general scientific career patterns over the next decade. Indeed, an increased emphasis on a "market" system of public-sector research funding will further reduce long-term career prospects and worsen perceptions of research careers.

— Two potential sources of improvement in career structures for life scientists are, (i) the proposals in the White Paper, "Realising Our Potential" aimed at increasing the volume of Science Vote funding which supports talented individual scientists, at the expense of project grant funding; and (ii) the projected growth of the bio-based industries as the potential of biotechnology is increasingly translated into new products and processes.

— The BBSRC is developing a range of initiatives to increase mobility between industry and the science base; there is considerable scope for industry and commerce to expand their recruitment of scientists who have doctoral and post-doctoral research experience. Means to stimulate recruitment should be adopted.

— The BBSRC is pursuing a vigorous programme of initiatives designed to address the concerns of woman scientists. A comprehensive national programme to improve childcare and maternity leave provisions and to support women scientists returning to work is desirable.

— The BBSRC is implementing the White Paper's proposals for the improvement and broadening of PhD training, throughout its university community. The new research Master's courses which will be piloted from October 1995 will contribute to this process.

INTRODUCTION

1. The BBSRC was established in April 1994, through the incorporation of the assets and responsibilities of the former AFRC and the work of the Biotechnology Directorate and the Biological Sciences Committee of the former SERC. The Council's mission, as established by the White Paper, "Realising Our Potential" is:

— to promote and support high-quality basic, strategic and applied research and related postgraduate training relating to the understanding and exploitation of biological systems;

— to advance knowledge and technology, and provide trained scientists and engineers, which meet the needs of users and beneficiaries (including the agriculture, bioprocessing, chemical, food, healthcare, pharmaceutical and other biotechnological related industries), thereby contributing to the economic competitiveness of the United Kingdom and the quality of life;

— to provide advice, disseminate knowledge, and promote public understanding in the fields of biotechnology and the biological sciences.

2. The Council is a major employer of academic scientists in its eight grant-aided Research Institutes and in Horticulture Research International (a MAFF-controlled research organisation). Employing some 2,700 scientists with doctoral and graduate qualifications, these represent a major part of the science base in the biological and related life sciences. The Council is also a major funder of research within the universities. Currently some 2,000 Research Assistants and technicians are employed on grants from the BBSRC, predominantly in chemistry, biological sciences and engineering; and the council also supports 2,000 research students, almost all of whom are undertaking doctoral research.

3. The Council welcomes the Select Committee's interest in the subject of scientific careers. In common with many other organisations which made submissions to the Chancellor of the Duchy of Lancaster during the preparation of the White Paper, "Realising Our Potential", the former AFRC warned about the danger for the health of the UK science base of the growing perception of science as offering poor careers. The AFRC focused in particular on the "insecurity of the postdoctoral period, in which researchers face a succession of two-to-three-year short-term appointments on projects which often do not allow them to develop their own ideas". It is widely accepted that, although no career can offer an entirely reliable pattern of progression and reward, the pendulum has swung too strongly against stability and financial security in science careers, thus creating a negative attitude to science in a whole generation of students.

4. In recent years, this trend has been reinforced by the low levels of postgraduate student stipend in comparison with graduate starting salaries. In the biological sciences, studentships funded by charitable foundations have been significantly higher than those offered by the Research Councils and more accurately reflect the market conditions for attracting high quality scientists. Subsequent salary prospects in scientific research within universities and Council Institutes have also been perceived as unattractive, particularly in the early period of a research career. Evidence from secondary school careers advisers indicates that the perception of science as an insecure and poorly rewarded occupation has been particularly damaging on the career choices of the brightest students, whose range of options is widest.

5. The White Paper, "Realising our Potential", itself proposed a number of ways in which the careers issue could be tackled. The BBSRC is contributing to the implementation of those proposals and we comment below on what is being achieved. But, there are other issues which can only be tackled effectively by concerted action from all interested parties—government, industry, universities and Research Councils. We hope that the Select Committee's deliberations will provide a stimulus to such action.

What are the problems and advantages of the current career structures for academic scientists in the UK? What are the advantages and disadvantages of the growth in short-term research contracts in academic science?

6. Recent studies by Atkinson *et al* (1992) and Connor *et al* (1993) have shown that over the past 15 years, the number of wholly university funded academic posts in science and engineering has remained static or declined slightly, while the number of posts funded partially or wholly from non-university sources has approximately doubled. The growth of the latter group primarily reflects a substantial increase in the number of postdoctoral contract research staff. The increase in the numbers of contract researchers has been due to the remarkable success of the universities in attracting contract research work over the past decade and a half. Between 1980 and 1989, the proportion of Research Assistant posts in universities funded from private and charitable sources rose from 26 to 44 per cent. However, increased contract research funding has not been accompanied by a commensurate increase in the number of lecturer posts and in other long term posts in scientific research.

7. These changes have undermined the traditional career structure for academic scientists, which led from a successful PhD into industry or university lecturer posts, typically after one or two postdoctoral contract appointments. The expectation of spending six to eight years on postdoctoral contracts has probably been more typical historically of the biological sciences, than of chemistry and engineering/physical sciences where much shorter postdoctoral periods prior to "permanent" employment were expected. The growth in postdoctoral contract research posts has sucked larger numbers of able scientists into a research career, but the expected routes for subsequent progression into mid- and late-career phases have not been created. Employment of PhD qualified scientists by private industry and commerce has remained stable during this period and has not provided a strong alternative demand.

8. The growth in output of PhD-qualified scientists during the 1980s has varied between disciplines. Table 1 shows increases of just over 30 per cent in biology and veterinary science, 18 per cent in the physical sciences and 44 per cent in engineering and technology. These figures have to be set against the fact that, by 1991, some 35 per cent of doctoral graduates were from overseas. While the supply of newly-qualified PhD scientists has increased, the very low unemployment rates of between 2 and 3 per cent indicate that there has been adequate initial demand to absorb them into the labour market. What has been lacking has been subsequent demand for more experienced researchers, allowing career structures to evolve which support progression and development beyond the initial period.

Table 1

Doctorates awarded 1980 and 1991 by subject group

	1980	*1991*	*% Growth*
Medicine	430	517	20.2
Allied to Medicine	182	357	96.2
Biology	947	1,248	31.8
Veterinary Science	176	232	31.8
Physical Sciences	1,467	1,730	17.9
Engineering and Technology	1,005	1,447	44.0
All Subjects	6,195	8,200	32.4

Source: Table 3.3, *Connor and Jagger*, 1993

9. Experience within the Council's eight grant-aided research institutes has closely paralleled the pattern of employment within the universities. The institutes' funding base has steadily widened; less than half of the income of most institutes is now derived from the Science Vote. Since the new sources of contract funding are mainly of a short-term nature, the proportion of scientific posts offered on a long-term basis has declined rapidly, with commensurate increases in the number and proportion of short-term contract posts. Of the 2,700 scientific posts mentioned in paragraph 2, around one-third are short-term contracts; a decade ago, one-twentieth were short-term. Only 20 per cent of post-doctoral recruitment to the research institutes is to "permanent" posts, and this proportion is still falling. The moves towards a more open research "market", which are linked to the proposal to place the whole of the MAFF research commission onto a three-year contract basis, will further reduce the institutes' ability to offer long-term career prospects.

10. The growth of fixed-term posts across the UK science base has undoubtedly provided considerable flexibility for research funders and for the employing universities and research institutes. A large pool of skilled but casualised researchers has been created, which can be drawn upon as necessary to carry out particular research projects. This flexibility allows fluctuations in funding to be accommodated without the heavy frictional costs and demoralisation associated with dismissal of "permanent" staff. It also allows project leaders to introduce new blood into research teams. Mobility between successive short-term posts can also have positive effects in the transfer of experience between laboratories, the introduction of alternative approaches to research designs and the development of research networking. These factors contribute much to the strengths of British science.

11. These benefits are, however, counterbalanced by the high turnover among trained staff which leads to the loss of accumulated expertise and research momentum, to a pervasive sense of insecurity and the lack of personal career growth and the personal disruption involved in moving between projects. Short-term contracts and personal flexibility are acceptable when young scientists can expect to obtain a satisfying longer-term research post or research/teaching post at the end of the road, with some degree of confidence. Since this is no longer the case, fewer high-quality young people seem prepared to take the risks involved; if there is a resumption of more general employment growth, the problem is likely to be exacerbated. The growth in short-term contracts is becoming self-defeating as young people of the highest quality are not being attracted to them.

How do you expect the situation to change in the next decade?

12. A report on "The Recruitment of PhD Science Graduates" produced for the SERC in 1993 by the Institute of Manpower Studies (Connor *et al* 1993), estimated future demand from the universities for science PhDs. The relevant chapter is appended *(not printed)*. Key conclusions were:

- There was a small reduction in the total number of university posts in Biology and Chemistry from 1989–92, accompanied by a reduction in recruitment to those areas.
- More than 40 per cent of academic scientists are likely to retire or die in service during the next 12 years. If future recruitment simply replaces existing stock, annual intakes from 1993 onwards would roughly double to between 120 and 140 in biology, and between 100 and 115 in chemistry.
- If recruitment expanded to match the projected expansion of student numbers, there would be much larger recruitment requirements between 1994 and 1999 in biology, and between 1996 and 1999 in chemistry, as the staff who entered during the university expansion period in the 1960s and early 1970s reach retirement. Since student numbers are now projected to be broadly stable beyond 1995, the higher recruitment rates seem unlikely to be attained.

Set against the 2,000–2,500 post-doctoral life sciences researchers in grade RA IA in the universities, even the higher levels of intake suggest that the impact on career prospects derived from recruitment to permanent university posts will be relatively limited up to the end of the century. There appears to be no prospect of a substantial increase in funding to the universities to support a major expansion of longer-term research and teaching appointments which would reverse the scientific career imbalance which has emerged over the past 15 years.

13. The same report also looked at the potential future demand for PhD scientists from private industry and the non-university public sector. Table 2, taken from the report, shows the stock of PhD scientists by discipline among private-sector firms in the IMS sample survey in 1992. For biology and chemistry, the survey showed that the bulk of recruitment took place immediately post-PhD, with only 12-20 per cent of recruitment occurring at the post-doctoral level. Although accurate evidence on future recruitment requirements is notoriously difficult to collect, some two-thirds of the organisations in the survey expected recruitment levels up to the end of the decade to stay broadly the same, and one-third expected them to increase. The volume of recruitment would depend on general business expansion, the need for specialist skills, and companies' R and D investment strategies. A similar pattern of expectations was identified amongst public sector employers, with a slightly smaller proportion predicting an increase. This limited evidence suggests that there will be little demand-side change affecting general scientific career patterns over the next decade, unless there is a major stimulus to private sector R and D from wider economic and business growth. One other factor which might increase the demand specifically for post-doctoral life scientists is the growing maturity of the biotechnology industry. Private research for the SERC Biotechnology Directorate (BTD) in 1993 showed an increasing demand for BTD-funded PhD students from industry relative to other sectors, and confirmed that biotechnology depends to a much greater extent on academic research and postgraduate training to produce its high level skill supply. (Connor, Jagger and Hall, 1993). Recent ESRC-funded research on innovation also showed the close interdependence of the science base in biotechnology and the company sector. If the projected growth of output from the bio-based industries occurs, there could be a significant increase in the extent of movement from post-doctoral research posts in the science base to jobs in industry.

Table 2

Distribution of PhD Scientists Employed in the Private Sector by Discipline

	Number PhDs	*Per cent total*	*Number employing organisations*	*Per cent organisations employing*
Biology	663	24.2	45	45.0
Chemistry	1,126	41.0	65	65.1
MSE	272	9.9	39	39.0
Mathematics	234	8.5	37	37.0
Physics	448	16.3	53	53.0
Total	2,743	100.0	108[1]	93.3[1]

[1] Includes those unable to provide a breakdown

Source: Table 3.2, *Connor et al,* 1993

14. On the supply side a change which would reduce the numbers of scientists embarking on the initial stages of a research career in a grant-supported post would be a shift in Research Council funding away from projects to people. The White Paper "Realising Our Potential" advocated this approach, building on a suggestion from the Royal Society. It proposed that Fellowship Schemes and other forms of long-term funding of talented individuals, should be expanded at the expense of conventional three-year project grants. These changes would reduce the demand for PhD qualified Research assistants and provide an avenue for career development for the most able of the RA labour force. The effect of creating a greater number of Fellowships would, however, be to increase the demand for Research Council grants from within a reduced budget allocation.

15. The Office of Science and Technology is coordinating the response of the Research Councils and the other funding bodies to the proposals in the White Paper. Two main strands of policy have been pursued:

- Discussions with the CVCP, and in the Science and Engineering Base Coordinating Committee, are aimed at improving the conditions of employment and personnel management of contract research staff.
- The funding bodies are reviewing the level and proportion of their resources allocated to Fellowships and other longer-term funding of research posts.

The reality is, however, that unless the Research Councils and the university Funding Councils between them significantly increase the volume of resource to support long-term posts, the current imbalance in the structure of research employment is likely to continue. The same funds cannot be used simultaneously to support both flexible and stable employment. Imaginative proposals have been put forward by, for example, University College London (for a formal procedure which would provide some researchers with open-ended contracts), and the Association of Researchers in Medicine and Science (for the creation of an "accredited researcher" status which would give access to more stable employment). Devising such schemes is not difficult but they can only have an impact on careers if the volume of funding made available on a long-term secure basis to support "permanent" posts is increased. In practice, since private sector funding is intrinsically linked to short-term contracts, the onus is on the government sector to increase long-term funding, or at the very least to take a coherent overall view of the optimal balance between short and long-term funding.

16. A rather wider set of changes in the pattern of demand and supply for academic scientists may be desirable if the nation's investment in science is to be used most effectively. Labour market studies indicate that the market for science doctorates has not broadened significantly into non-scientific work in the way that it has developed in other disciplines. A very large proportion of science PhD's are employed in R and D and support services, within a relatively small number of large organisations. The IMS report estimated that only 3-4 per cent of small and medium-sized enterprises (10-500 employees) employ a PhD qualified scientist. Relatively few enter secondary school teaching. Whether at the immediate post PhD point or after some post-doctoral research experience on a short-term contract, it would be desirable for the range of career options actively on offer to be widened. Potential methods of encouraging highly qualified scientists into these areas of economic activity would be through bursary schemes which, for example, would provide an SME with a pump-priming grant for two to three years to support the employment of a postdoctoral scientist, or would provide a salary supplement to a teacher with a PhD qualification during the early period of a career in education.

What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?

17. Table 3, from Atkinson et al (1992) shows the first destination of over 9,000 SERC-funded Research Assistants who left their positions between 1980 and 1989 by nationality group. About half fall into the residual category "Other (in UK)" which was used for those for whom no employer was known; roughly equal numbers (18/19 per cent of the total) go to jobs in UK industry and commerce and to university and other education posts.

Table 3

SERC-funded Research Assistants 1980–81 by nationality group and first destination on leaving

	UK	*Co'wealth*	*Other O'seas*	*Total*
First Destination				
UK University	855	102	104	1,102
Other UK Education	167	7	14	188
Overseas University	208	169	305	682
Student	154	14	27	195
Industry and Commerce	1,186	74	100	1,360
NHS	23			23
Central Government	151	11	7	169
Local Government	42		1	43
Public Corporation	75	4	6	85
Self Employed	39	3	4	46
Other (in UK)	3,315	428	805	4,548
Outside UK	215	158	270	643
Miscellaneous	95	7	12	114
Total	6,525	977	1,696	9,198

Source: Table 34, H Atkinson et al, *An Analysis of Research Personnel in UK Universities,* 1992

18. Table 4 shows for a sample of leading firms only, in 1992, the number of scientists with a recent PhD and with post doctoral experience recruited by a sample of major private sector firms.

Table 4

PhD Scientists Recruited in the Private Sector, by discipline, 1992 IMS Survey

	PhDs Recruited	*Post Docs Recruited*
Biology	45	12
Chemistry	78	23
Maths	15	2
Physics	18	3
Total	156	50

Source: Table 3.5 and Figure 3.2 *H. Connor et al,* 1993

19. In order to gather some more specific and useful data on the subsequent employment patterns of contract research staff, the BBSRC will shortly be undertaking a comprehensive follow-up exercise of the 120 Research Assistants employed on the first phase of the Council's Plant Molecular Biology programme. Similar exercises are planned for other groups of contract staff.

What should be done to improve the mobility of scientists between academia and industry?

20. The Research Institutes supported by the BBSRC have historically experienced a small but steady trickle of scientists moving out into industry or from industry into the science base. At the higher levels of experience and seniority, the major obstacle to industrial scientists moving into the science base is the lower level of salary and other benefits, and there are relatively few entirely voluntary moves. The BBSRC has experienced considerable difficulties in recent recruitment exercises for senior institute posts in being able to attract candidates with an industrial background with a sufficiently satisfactory remuneration package. Although the new flexibilities derived from the introduction of the BBSRC's own pay and grading system may improve the situation, the differentials will still be very wide.

21. Transfers from universities and institutes to industry encounter fewer financial barriers, and, particularly in early and mid-career, the financial rewards are often a major incentive. Industrial companies are inevitably encouraged to "cherry-pick" talented researchers who are working on projects which seem likely to bring an early pay-off to the company. However, the evidence from the labour-market studies quoted above suggests that there is scope for industry and commerce to expand their recruitment of scientists with postdoctoral research experience. The main obstacle seems to be that company recruitment policies are geared to taking on newly-graduated PhD students and offering them a strong career orientation, using the internal labour market to develop and promote as appropriate. As suggested earlier, there is probably considerable potential within the SME sector to generate more employment opportunities for academic scientists, but the employers' weakly-formed perceptions of the possible value of highly-trained scientific staff are still a major obstacle.

22. At the practical level, BBSRC has taken two initiatives in recent months which will contribute to improved mobility between the science base and industry.

- As part of the Innovative Manufacturing Initiative, the Council will be supporting a number of postdoctoral fellows as associates under the Teaching Company Scheme; they will be placed in companies (particularly SMEs) for a couple of years to carry out a research project in collaboration with a university partner. We hope that this will provide the basis for further SME/science base collaboration over the longer term, as well as opening up new career opportunities.
- Under the Industrial CASE Scheme, we are asking industrial partners to commit themselves to employing the postgraduate student within the company for significantly more than the three-month minimum in the current CASE rules, and to providing additional business-related training. This additional training is designed to encourage the student and the partner companies to consider the potential of science postgraduates for a wider range of posts within the enterprise. BBSRC hopes to make some 100 Industrial CASE awards this year, a five-fold increase over 1994.

Women in Science and Engineering: what should be done to make scientific careers more attractive to women, and how?

23. The BBSRC has adopted a vigorous programme of initiatives designed to address the concerns of women scientists. The Chief Executive has taken a strong personal lead in identifying and tackling barriers to equality of opportunity. At first degree level, female and male representation in the biological sciences are broadly equal, and over one-third of PhD graduates in the biological sciences are female. With the recent expansion of higher education, the UK is likely to experience similar trends to the US where female PhD graduates will outnumber men by the end of the century. As the OST report "The Rising Tide" indicated, a successful future for UK science depends on our capacity to mobilise the full range of available skills and talents; measures to ensure equality of opportunity are critical.

> "The future of scientific research depends on an equal contribution from men and women. We need to take every possible measure to ensure equality of opportunity is achieved". (Tom Blundell, Chief Executive BBSRC, *THES*, 25 November 1994).

24. Many of the issues involved in making scientific careers more attractive to women focus on removing the obstacles to combining a worthwhile career with childbearing and rearing. Maternity provisions and childcare facilities are key factors. The Council has recently introduced measures to tackle these elements for the scientists which it supports, both directly and indirectly.

- The conditions applying to Research Fellowships have been amended to make them more attractive to women. In future, a woman who is awarded a Fellowship will be able to take it to another university if she has to move for domestic reasons. In the event of pregnancy, Fellows are entitled to up to six months maternity leave on full pay, and the Council will meet the costs of placing the award in abeyance for the leave period. Flexible working arrangements are available for women scientists after the return to work, and to male partners wishing to share the responsibilities for child rearing.

- Women scientists in the Research Institute with at least six months service, including those on short term contracts, are now entitled to up to 18 weeks maternity leave on full pay. Flexible working arrangements are encouraged to facilitate the return to work.
- For research workers employed in universities on BBSRC grants, the BBSRC supports the proposals that are being discussed currently between the CVCP and the OST. These would secure equality of treatment between research staff and permanent members of academic staff in relation to maternity, and the Research Councils would meet the costs of temporarily suspending the grant while the Research Assistant is on maternity leave.
- A commitment has been made to secure access to affordable and good quality child-care at all Research Institute sites by the end of 1995.

25. While these practical steps to support women's participation in science throughout a lifetime's career are of critical importance, they obviously do not remove some of the more intangible disincentives to women seeking a career in science.

- It is difficult to combine a succession of short-term post-doctoral appointments involving geographical mobility with a stable domestic partnership and childbearing. BBSRC Research Institute data shows that the largest number of women opt out of a scientific career at the end of the first postdoctoral period, when it is likely that a more stable work environment is being sought. The labour-market changes of the last decade (paragraph 5 above) thus act as a direct disincentive to equality of opportunity.
- Since promotion and scientific merit is frequently assessed by the volume of research output (eg numbers of referred papers), time taken off for maternity and child-care may have a negative impact on women scientists through the loss of research momentum and a reduction in the output of publications.
- If a women scientist wishes to re-enter research work after a period outside the labour market, she may not have the appropriate recent experience to secure a post that is commensurate with her intrinsic work; a national programme of "returner" Fellowships or scholarships may be an appropriate means of overcoming this problem.

26. Following the "Rising Tide" report, it would be appropriate for the government to take an initiative to ensure adequate and affordable childcare facilities and good maternity leave provisions throughout the science base. This would require additional financial resources to be made available specifically for these purposes. Ringing endorsements of the principles of equal opportunity in science are unconvincing if they are accompanied by a shifting of the financial responsibility to cash-poor institutions which are then forced to cut jobs or equipment budgets to meet this particular objective.

The M.Res degree will be piloted from October 1995; what is the worth of this scheme?

27. The BBSRC currently supports very few advanced (Master's) courses. The Council's stock of postgraduate training places consists of 1920 PhD places and only 80 advanced course places. This distribution reflects the demand from the Council's user communities for doctoral research training rather than shorter periods of conversion of "top-up" training. Users in the bio-based industries have not generally welcomed the new Research Master's degree, although widespread support has been expressed for the White Paper's underlying objective of broadening the content of postgraduate training to include a greater element of transferable skills. The Council welcomed the government's decision not to make the new degree a prerequisite for a PhD, and to allow students to proceed to a PhD from a Research Master's degree.

28. Following that decision, BBSRC has launched a pilot programme of nine self-standing Research Master's programmes, each with five funded places. The pilot programmes have been selected from over 50 applications to provide:

- a high quality research training environment;
- an innovative programme of wider training in research skills and general employment competencies; and
- collaborative relationships with industrial users of research.

They will be carefully monitored, in particular to see whether the one-year training format leads directly to employment opportunities, whether students and user industries consider the content to provide a satisfactory blend of the three main elements, and in cases where students graduating from these courses move on subsequently to do a PhD, whether it contributes to a successful completion of that higher degree.

29. In parallel, the Council will be implementing the White Paper's more general theme, which itself reflected the outcome of recent Research Council consultation exercises with employers. It has been widely

accepted that the modern PhD should go beyond the confines of a narrow research topic and should include more interpersonal skills training, increased training in business awareness and understanding, and an emphasis on the development of a broader overview of the student's discipline so as to increase subsequent employment flexibility. Most of the university departments which will receive BBSRC training awards in 1995–96 are already providing large elements of this portfolio of skills. There has been a significant development in the range and content of supporting modules in recent years, and the new Council intends to stimulate this process over the next two years. To the extent that it is possible within the three-year timeframe, our objective is to secure general application of the training principles endorsed by the White Paper.

January 1995

Examination of witnesses

PROFESSOR T L BLUNDELL, FRS, Chief Executive, MR R J PRICE, Director, Human resources, Biotechnology and Biological Sciences Research Council, called in and examined.

Chairman

532. Thank you very much indeed, Professor Blundell and Mr Price, for coming today. I think you know the kind of problem which we are examining which have a number of aspects. It is really in three parts; one of course is the general problem of contract research staff; another is the case of women; and the other is the Master of Research degree. We did give you questions. You have kindly provided us not only with a paper beforehand but I see another batch round here. Would it be helpful if you were to make a statement generally of your own position to begin with and then perhaps we can go on to questions or would you like to go straight into questions?

(*Professor Blundell*) I would be happy to make a very short statement. Research councils have two areas of responsibility. One, of course, is to carry out excellent research and the other is to support training and provide scientifically trained manpower for industry, for academia and for other walks of life. It is getting the balance between those two responsibilities right, which is the challenge for us. There clearly are advantages to science in having flexibility in contracts. It allows one to change direction in science without heavy costs of redundancies which we know very well in the institute-based research areas of our council. It also allows one to have transfer of expertise between research groups and to have a very fast flow of information between different research areas. So there are positive aspects of a flexible contract system. I think many would argue that a lot of the strengths of British science have been based on that. Nevertheless there are also aspects of long-term career progression that we have a responsibility for. The retention of expertise in long-term appointments is also important. Furthermore, if we do not provide a career path at the post-doctoral level then there will be a negative effect on the intake at the post-doctoral level. When there are many opportunities in the economy, we will then begin to see, I think, a downturn in quality. These are both rather selfish aspects concerned with optimising research. Of course there is the very positive aspect of making sure the scientists are well trained and they do have a fulfilling research career. Balancing these two aspects is quite difficult within a fixed resource and that is what we, as a new research council, are considering very carefully. We have taken a number of initiatives which are designed to improve careers for research staff, some of those in collaboration with the Office of Science and Technology. But making contracts longer has to be seen against the background of a very low success rate in the contract funding scheme, a 20 per cent success rate across the board in our research council in this last grants round.

533. Just for the benefit of Members of the Committee who may not understand that term, a 20 per cent success rate means one in five of the applicants only get a grant, does it?

(*Professor Blundell*) Yes, that is right. Of course, if one is going to move to longer-term career planning to funding more longer term independent fellowships, then the opportunities in the shorter term research grants over the three year period become restrained and that just emphasises the problems we need to solve. Maybe I should stop at that point. I think that summarises the problems we face in getting the balance right.

534. Many people have said to us that there is a deterrent effect on good people of this system but we have not actually had any evidence of this, partly I suppose because it is very difficult to prove a negative. I wonder if there is not another factor, on which I certainly would like to have your views, and that is the present arrangements in which people feel, how shall I put it, that their chance of getting another grant or of being appointed as an assistant on another grant depends upon attracting a track record of publishable work and that the pressure to publish now has become so intense that people are going for safe research and the really speculative, quality, original research tends to be squeezed out. That, if true, would be a very very sad thing indeed and would not bode well for the future. Have you any views on that?

(*Professor Blundell*) There has to be some element of that, I think, in short-term funding, although skilled operators of the system do manage to create some continuity in their research plans even though they are relatively short research grants. But I agree that schemes that fund research over a longer time, such as that which funds my own research through the Imperial Cancer Research Fund over five years, certainly give a more relaxed approach to more imaginative science.

535. Are you arguing for longer term contracts really and award to individuals rather than to project leaders?

[Chairman *contd.*]

(*Professor Blundell*) I think in the longer term we would like to move in that direction. The restraint comes from the fact I have outlined earlier and that is that if we start moving to longer term individual-based fellowships, then the success rate in the grants round is going to fall even below 20 per cent. I think that would also have a very negative effect on the scientific community so there is a question of getting the balance right. We should, of course, remember that our council has about 50 per cent of its activity in research institutes and they, of course, do have longer term appointments. But even there the pressure for flexibility has meant roughly a third of the employees are now on short-term contracts.

Baroness Platt of Writtle

536. Might there not be an advantage in having the three year contracts for the younger research workers going to longer term when they have, as it were, proved their worth and also proved the character of their research?

(*Professor Blundell*) That is generally the scheme that we would like to see pursued. That is, of course, what the Royal Society has very strongly supported. Other institutions are also following. We intend to expand our research fellowship scheme, which would give five-year appointments. But there is, of course, a problem on two aspects of that. First, the five-year appointees want to have their own grants and quite often their own post-doctorals. There could be a chain-letter effect in that if one is not careful one generates a lot of unsatisfied new grant applicants because generally the five-year fellows are allowed to compete in the research market. Of course, one to some extent just puts the problem of a longer term career off for five years. However, five year fellowships allow people to think more imaginatively about their research programme in a very productive phase of their research career.

Baroness Hilton of Eggardon

537. I was interested in what you said about the skilled operators of the system and I wondered whether you saw a positive correlative between that and young, good scientists, or a negative correlation? My experience of entrepreneurial wheeler-dealer people is that they are not people who will actually settle down and perhaps be good research scientists, which is a different sort of skill.

(*Professor Blundell*) I am not sure that the distribution of the two populations is correlated in any way.

538. No, I was asking for an opinion.

(*Professor Blundell*) Indeed science does depend very much, under the present system, on an entrepreneurial spirit. One is constantly having to look for opportunities for funding and it is indeed generally very short term funding, so that skill is very important in the present university system.

539. But it might work against the contemplative long-term thinking skills you need for really creative science?

(*Professor Blundell*) I think that is true.

Lord Craig of Radley

540. Does that not then raise a question about how you identify young people of the highest quality who you are suggesting may be put off by short-term contracts? My contention might be that if they are of the highest quality they will then have sufficient confidence in themselves to tackle the future, even if it is based on a short-term contract environment. Indeed, many of their age group in other professions are finding that short-term contracts are much more the norm than perhaps they used to be when I was a boy and even when perhaps you were a boy?

(*Professor Blundell*) It is certainly true that many post-doctoral research scientists are willing to take on a long-term project with short-term funding. I myself took on a project which my supervisor, Dorothy Hodgkin, had started 30 years before; people at that stage in their career like challenges. But I think one can only do that to a limited extent and there begins to be a feedback which is negative.

541. But not necessarily affecting those of the highest quality?

(*Professor Blundell*) Hopefully not.

Baroness Hilton of Eggardon

542. It depends on what qualities you are looking at perhaps, does it not?

(*Professor Blundell*) Yes. I think one of the problems about quality is that it is clear that one cannot simply identify quality from the first degree. In the biological sciences, which are very multidisciplinary, it is difficult even after a PhD. We need high-quality scientists with a knowledge of a very broad area and an ability to innovate, to come up with new ideas. I think one identifies that sort of person in the post-doctoral period.

Lord Craig of Radley

543. In the first three years perhaps?

(*Professor Blundell*) Hopefully in that period.

544. In which case, surely that is a very good argument—I am sorry, I am being a bit of a devil's advocate—for the short-term contract in order to identify who are the people in whom we really have great confidence for the longer-term science research future?

(*Professor Blundell*) Yes. I think a system in which one has a post-doctoral appointment of, say, three years and then the possibility of a five-year fellowship is a good one. It does not, however, solve the problem of the general negative feeling about career prospects, of salary and remuneration in the longer term, which is what I was addressing earlier on.

Baroness Hilton of Eggardon

545. Is not one of the problems that there is absolutely no system as such, that there is not any system for managing people's careers by identifying the really bright people, because they are dependent on finding new contracts and finance to help them up rather than a natural career planning system?

[Baroness Hilton of Eggardon *contd.*]

(*Professor Blundell*) Certainly there is no formal system at the moment but maybe I should bring in Bob Price and ask him to comment on the general thinking.

Chairman: Before you do that, Lord Phillips has been aching to ask a question. We will come to that point.

Lord Phillips of Ellesmere

546. It is related to the discussion that has just been going on. You have in a sense within your own hands a microcosm of the overall science base in your own institutes? There, as you have said, you have a proportion of people on short-term contracts and you probably still have a number of people who were appointed some time ago and have what we still affectionately call tenure, but how do you see the longer-term future for the staffing of your institutes? What do you think would be the ideal pattern of appointments in one of these institutes?

(*Professor Blundell*) That is a subject we are reviewing in the Council now. I think the answer can be in two forms, one pattern that would in a perfect world be optimum and the other is a pattern that is optimal under the present funding arrangements. We are moving to government departments having more commissions or contracts over three-year periods, to an increased funding from industry, which again is over a short period, and an increased requirement—and not a bad requirement—to have competition between different kinds of research institutions in co-ordinated programmes, for example. Although we can move experienced scientists from one project to another, we must have a reasonable percentage of short-term contracts in order to allow the flexibility of the institute to move from one specialised area to the other in response to the research market. So my answer would be that the average in our research council institutes is probably not too far away from an optimum of about one-third being on short-term contracts. That gives flexibility. We get into serious problems when an institute has very few people on short-term contracts. We cannot then respond to a complete change of policy over a very short period of time from a commissioning department like MAFF. So in terms of the present research environment I think one needs to have some flexibility. Of course we also need to have longer-term appointments to provide continuity and expertise.

547. But this, if I may say so, my Lord Chairman, is not very different from the situation in universities where the proportion of funds which come from what used to be called the secure block grant has decreased and the proportion that comes from short-term contracts, from research councils, from charities, from industry, has increased. So just as industry has to maintain a more or less permanent staff to do work which is very often of short duration and of not guaranteed continuity, so the universities and the research institutes have to learn how to do the same thing. Is that not a problem?

(*Professor Blundell*) That is indeed the problem and I think many of our research institutes are now quite skilled at doing that. However, there is an historical position: some institutes have very few short-term contracts and have little flexibility. They tend to have been the ones which are closest to policy areas supported by government departments, and that is where the tension comes at the moment.

548. Could I, my Lord Chairman, just finally say that industry I think quite often manages to support people on relatively long-term contracts. They do not have jobs for life, so to speak, but they manage their portfolio of short-term jobs in such a way that a cadre of people stay on in the same industry for quite a long period of time. Is that not really a question of management, how many really short-term appointments you have and how many somewhat longer term appointments you have?

(*Professor Blundell*) Of course it was subsumed in my answer that we could not possibly manage on one third of total staff being short-term if they were the only ones on short-term contracts. A much larger proportion of our funding in institutes is often for three years. A large number of our tenured staff are on short-term contracts and we manage it so they move from one short-term contract to another. Of course, as you know, in many areas there have been very fast rates of change in this science, there are demands for new expertise, and the short-term contracts offer some flexibility to bring in this new expertise.

Chairman

549. This discussion we are now having reminds me of a similar discussion 25 years' ago when the notion of short-term contracts and commissioning work from the research councils was a very active subject. Some of us felt at that time that the increase in very short-term contracts would inevitably have an effect in swinging the balance as you put it. I am going to use different words, from what you might say long-term future prospects of basic work to short-term work. For this purpose we urged, and it was then accepted, that there would be a research surcharge on the short-term contracts. Has that idea been abandoned by your research council and others?

(*Professor Blundell*) You are referring to the Rothschild principle of, whatever it is, 11 or 15 per cent seedcorn basic research? The institutes operate, in fact, on a system which is not too different from that. They do not have an identified core programme but effectively from the Office of Science and Technology budget there is some flexibility for the director to take new initiatives, to invest in new people, in new areas, and to carry out new research. So that is absolutely essential. The problems become particularly acute where the amount of Office of Science Technology money is rather low. In two of our institutes it is only 20 per cent and a large proportion of funding is industry and MAFF. They do not follow that policy. I would certainly like to see the Rothschild principle applied openly by policy departments.

Chairman: It might be called the "enforced" Rothschild premium.

Lord Haskel

550. There is enormous pressure on industry at the moment to respond much more quickly to market changes and that is certainly something which occupies industry an awful lot of time. Do you think that this is being reflected in their short-term contracts with the research institutes? Is this one of the factors which is affecting their relationships with the institutes and causing these short-term contracts?

(*Professor Blundell*) Clearly a lot of the industrial funding is through short-term contracts, I think that is an undeniable fact. Indeed it is likely to increase. In the biologically-based industries there is a move towards the extreme model of a virtual company where the companies have smaller in-house core expertise and buy in their expertise on specialist areas from universities and small companies. I think that is going to increase as the companies become more biology-based, which I am sure, for example, the agro-chemical and pharmaceutical industries have to do, and as targets in their search for new molecules, drugs and new chemicals become more dependent on specific areas of biology into which companies will not wish to put permanent investment. I do see an increasing trend in much of the bio-based industry to out-sourcing a lot of their work, especially when they are exploring new targets. So we may see an increasing number of short-term contracts from industry in our area.

Chairman

551. Can you tell us before we leave this section what in quantitative terms is the balance between the kind of work which you would classify as long-term in terms of expenditure and also the *ad hoc* short-term work so we can get some idea of the order of magnitude?

(*Professor Blundell*) I would like to very carefully distinguish between long-term in vision, long-term in funding and long-term in appointment, because I really do think there is a distinction and it does cause some confusion. If we just confine ourselves to lengths of appointment then I think the figures I gave in the institutes are right, one-third is short-term and the percentage is increasing. In the funding in the universities with the exception of the academic staff and technicians then it is all short-term, three or five years for grants and fellowships and ten years for inter-disciplinary research centres (a relatively small proportion). These appointments on contracts probably comprise about 60 per cent of the research funding in a good university.

552. But we should not, according to you, go away with the impression that that very high proportion of short-term funding in universities implies that it is short-term tactical work?

(*Professor Blundell*) I think sometimes the flexibility of a short-term contract enables one to bring in a new expertise or a new idea to solve a long-term problem.

553. So this is a clear example, to use your terminology, where in fact there are great advantages even for long-term research of having the opportunity of short-term contracts?

(*Professor Blundell*) It has to be a balance.

554. And the problem is of course, as you have said, what about the individuals who are in fact moving from contract to contract, which is one of the issues we are really concerned with and how can it be managed.

(*Professor Blundell*) The arguments we have followed so far lead one to a position of having a third of the total resource on short-term appointments in the institutes and more in the universities. If one calculates how many post-doctoral appointments that implies, if they are three to six years, then we get to the kind of figures we have in the life sciences which is 2,000 to 2,500. One looks at the replacement requirements in the universities, which are running from 50 and increasing up to 120-150 in the next decade, and one immediately sees that there is an inequality. So one needs to ask the question, "What other opportunities are there outside academic research in universities and institutes?". We must also ask, "How can one manage the careers of people when they are in the short-term system?" One cause of problems has been the separation between the research councils and the universities in that the research councils have been the funders and the universities have been the employers. I have been involved over the past four or five years, since I have been head of a research council, in trying to agree a concordat between the universities and research councils which looks after the question of the careers of these shorter term contracts. That is just one aspect of the problem.

555. Can you put a figure on the kind of age by which you think it is the duty of a responsible employer to say to a young person who has been on several of these, "Now is the time you really must begin to face life and we have a duty to advise you whether you have a prospect to stay on or whether you should be seeking a career in some other area." Some of these young researchers going off into other activities other than academia, for example, is a very desirable thing for them as well as for this country?

(*Professor Blundell*) I would be unwilling to give you an age because I have spent the last 20 years of my career working at Birkbeck College where I have encouraged many people to come into science in their thirties and forties. A recent article in *The Times Higher* featured a Dr Alan Mills discussing the worldwide web: he came back to research in his forties! There are several people who have made impressive contributions to research, several of them women, who did their PhDs with me in their late thirties. My answer would be in terms of experience rather than age. I would want to measure the time they have been in the system. As I have already said, a three-year PhD and a three-year post-doc gives a good impression of whether people are suitable for a longer term career. I would not want to prevent people taking another post-doc but if they are not high fliers we should make it clear at that stage that the opportunities for going into academic research are rather small. It is then the responsibility of the system—the university, institute and research council—to ensure that other opportunities are considered. There must be an adequate training in skills which qualify people to take other career paths.

Lord Craig of Radley

556. Just before we leave all this, I wonder if you can help me with two comments in your very helpful paper, where you say that the former AFRC concluded that there was a negative attitude created to science in a whole generation of students as a result of the environment which you perceive that they are going to go into, but at the same time we are also told that: "While the supply of newly-qualified PhD scientists has increased, the very low unemployment rates of between 2 and 3 per cent indicate that there has been adequate initial demand to absorb them into the labour market." If there is a student perception that science is not a very good career to go into, yet we do not seem to find a very large number of them not being employed?

(*Professor Blundell*) I think the answer must be in what they are eventually employed as and what their salaries and opportunities are in career progression later.

(*Mr Price*) It is the initial unemployment rate of 2 or 3 per cent which is picked up by these figures. What it does not tell you is what happens after that in terms of their subsequent careers. The impression we have had very forcibly from careers advisers and people in universities who advise us on these matters is that the instability perceived in long-term research careers is dissuading students coming into science in the first place. So the PhDs do graduate, do get jobs, but because it is unstable after that that makes the image of the career they are getting for their peers and their other successors not an attractive one.

557. If science were more attractive presumably by definition we would end up with larger numbers of PhDs?

(*Mr Price*) That is regulated by the number of places offered by the research councils and other funding bodies, so there is a degree of regulation which would prevent the numbers necessarily reacting to market forces only.

(*Professor Blundell*) It is the quality that we are concerned with; I do not see it as a bad thing to have more high-quality people with a scientific training. I am very concerned that in the United Kingdom the opportunities for PhD scientists in other walks of life are not very great. It is very important for a society that must be based on technology to have knowledge of science and research in industry and policy-making. That opportunity in turn ultimately determines who you get into science. If a scientist or an engineer in Japan goes into science, they have a better opportunity of getting to the top of their company as a manager as well as becoming a professor in a university, and I think opportunities for both career paths are desirable.

Chairman

558. I think they do see it in Japan—and perhaps we should have more of that—as an investment in a person for a long period, even though the immediate pay-off may be rather more distant than here. Is that your impression?

(*Professor Blundell*) That is certainly our view. As I said at the beginning, we are devising policies now to try to pursue that kind of thinking.

559. Perhaps we ought to look at what you were hinting at before, namely, Lord Craig was bringing out these discussions you are having between the research councils and the Higher Education Funding Council leading ultimately to some kind of agreement, we hope, with the CVCP. Can you tell us how far that has gone?

(*Mr Price*) Yes, my Lord Chairman. The discussions so far have been at the level of the officials of the Research Councils with the OST. We have drawn up a draft concordat which I think is due to be discussed by the SEBCC, the Science and Engineering Base Co-ordinating Committee, which is a body bringing together the research council heads and the funding council heads.

560. So the stage of discussion actually with the heads of universities has not yet been reached?

(*Professor Blundell*) I believe the document has gone to the CVCP and they have had an initial response, but we have not had a further discussion in the light of the paper that has been prepared.

(*Mr Price*) It is intended, on the one hand, to improve the personnel management of research staff in universities to ensure that they get the right kind of treatment in terms of career advice, training, appraisal, and their own pay and conditions, and then to try to manage the exit point in a more effective way than in the past. So they would be given advice about their potential for long-term careers within the universities or research rather than the more hit-and-miss approach which is perhaps found today. On the other hand, we in the research councils would undertake to do two things. One is to look at the prospects for the longer-term funding to which Professor Blundell referred to create opportunities to pick up the best of the research assistant work force, and carry them forward over the longer term. We all also look at the possibilities of extending the number of fellowship schemes, which would actually allow post-doctorals to manage the transition from the three-year appointment to something longer and ultimately perhaps into a permanent post.

561. Yes. To the extent to which these research contract people's contracts become longer, they will then become more and more comparable to the regular academic staff for whom tenure has disappeared anyway?

(*Mr Price*) Yes.

562. So that will also lead to a parity of esteem which one hopes may also be reflected in both salaries and pensions. Is that what you are really aiming for?

(*Professor Blundell*) I think there are a lot of informal indications that staff on short-term contracts are not treated equally. As we move towards five-year fellowships and more equality of opportunity, then we should get more equality of treatment. But I think things have improved in many universities over the past few years. It is at last recognised that the short term research work force exist and they are usually encouraged to become members of the various organisations in the college or university.

563. It must, of course, have been that over the last 17 years the numbers have so increased that they are comparable in magnitude to the established—I will not use the word "tenured" any more—staff in the universities?

[Chairman *contd.*]

(*Professor Blundell*) Right.

(*Mr Price*) The difficulty is the one Professor Blundell referred to earlier, that of funding. If you put more money into fellowships and longer-term funding, then the amount available for responsive mode grants declines and the science base will suffer as a consequence. So we are caught between a rock and a hard place to a degree in that our funding is constrained. There are two objectives and you cannot meet both of them with the same pound note.

(*Professor Blundell*) But we can move towards it.

564. May we ask you a question which arises from the demography of the situation, so to speak, and that is that, of course, universities have been unable to make many appointments to the lecturer level, the lowest grades, over the last few years. The result of this is that the age profile is one which is moving up all the time and that means that at some future date which is not too far distant the situation could reverse itself when a lot of people drop off at the end. So to what extent do you think this is a temporary problem and part of the natural oscillation you get in any system which cannot be exactly matched with the time constants being different?

(*Professor Blundell*) I do not think it is a temporary problem. The replacement numbers were 50 last year and will be 170 in the year 2000. However, we have 2,500 research assistants in place. So moving from 50 to 170 may do something to change the climate but it is certainly not going to solve the problem. The future for most of the post-doctorals cannot be in university academic/research positions or, indeed, in institutes. It has to be in their taking a range of different opportunities for careers outside publicly funded research.

(*Mr Price*) The problem is great not because of a decline in the number of permanent posts, but because of the expansion in the number of short-term posts which you picked up before. That does not seem likely to go away. The number of short-term contracts is likely to stay at that kind of level and may even be expanding, so that the relationships between short-term funding and the opportunities for longer-term university appointments is going to remain very much out of line.

565. But the Scottish Higher Education Funding Council is so concerned with this situation it thinks it is desirable to resuscitate the old new blood plus the premature voluntary retirement scheme. Are you saying that is not really necessary and if it were it would not meet the problem?

(*Professor Blundell*) I think new blood schemes of that kind do give encouragement and they would be welcome.

566. Perhaps we should move on and the natural step to go to now is the question of the problem of women in science on which we have had quite a number of representations and which we are concerned about. I know it is a matter in which you yourself, Professor Blundell, have taken a good deal of interest. Would you like to give us your perception of it?

(*Professor Blundell*) As you say, my Lord Chairman, it is a subject in which I have had a keen interest. In the life sciences roughly 50 per cent of our intake at the post-graduate level are women. They are obviously equally good as the men. However, for senior lecturers in universities or senior research group Readers in institutes there are only to ten to 15 per cent women. We have clearly lost a resource. It is a loss for the individuals concerned and it is a loss for the system as well. We are doing a number of things; the first is to get some statistics and to understand at which point we lose women from the system. Of course the answer is that we lose them at almost every stage but the end of the first post-doctoral appointment is a particularly serious time. One sees quite a lot of women in post-doctoral positions but very few women lecturers. There is the same difference in the equivalent positions in the institutes. That time often coincides with child bearing. Bob Price and his team have taken the initiative to see where childcare facilities are required. Our institute directors have been encouraged to invest in facilities. It is not cheap, it costs £60,000 to set up a crèche. We also try to make sure that the woman on a research grant is not disadvantaged. We plan to extend the research grant so that the time a woman is doing research, even if she has time off for maternity leave, is not less than three years and we will fund a replacement during the maternity leave. Where the supervisor is a women, we will provide help so that she can keep in contact with her research team, and she can access the library. We have costed these new policies. In the institutes and for our long-term fellowships we have implemented them directly. In the case of the universities we are, together with OST and other research councils, moving towards a concordat with the universities. We believe that the universities and research councils should share the costs.

567. Whichever of you answers is preferred, can you tell us have you any kind of figure which would give us what the Americans call a ball-park idea of the extra cost of doing a particular piece of work over a period of years of employing women rather than men, particularly in this difficult age where they may be lost to the system when those opportunities of spending a little money to involve them are not there?

(*Mr Price*) We have not, my Lord Chairman, worked out figures of exactly that type. What we have done is to look at the cost of two things. One is the cost of child care where we would cost the initial capital facility at an average of £60,000 for a conversion of an existing building to a 20 place creche.

568. Do you charge the parents?

(*Mr Price*) Yes, it is about a £100 a week, a typical cost. Of course for the staff less well paid than a scientist we might well subsidise that but a scientist would pay the full cost. That £60,000 is the capital sum sunk into it and is in a sense a subsidy that is a legitimate cost over and above other employment costs. In the universities or elsewhere the cost is first of all the cost of maternity pay and then of course the cost of any replacements which are necessary because the contract has taken a little longer because of the maternity leave and those two costs between them in a typical case add a very small proportion to a total grant, we estimate that about three per cent would be a typical figure.

[Chairman *contd.*]

569. As little as that?

(*Mr Price*) That is taken across the whole system. Clearly individual contracts might be slightly more or less but that is the approximate overall cost across the system.

570. I think that is a very significant figure to have on the table as it were because I had imagined it would be larger than that.

(*Mr Price*) We can provide you with the costings which backed up the initial work on the concordat and which go into great detail on the funding areas across the BBSRC if you would like to have them.

Chairman: I think that would be quite interesting. I look to my Baronesses.

Baroness Platt of Writtle

571. The other thing I would like to ask you is whether you did what the Engineering Council did which was to approach it from the opposite point of view to cost out the loss to the country of the cost of both education and training of women engineers if they left the system.

(*Professor Blundell*) The simple answer is contained within the statistics that I gave earlier. If we have 50 per cent of women coming into the system and we only have ten to 15 per cent in the higher grades we are losing 35 per cent of our investment. This is a huge sum of money compared with the average increase of costs over the whole system to provide extra maternity payments and creches.

Baroness of Hilton of Eggardon

572. Could I also make the point about creches that they actually help single parents who are male. In the Metropolitan Police when we set up a organisation for single parents, there were some very offended male officers having to cope with bringing up small families themselves and it was not only women.

(*Professor Blundell*) The creches are open to anyone.

573. I think people assume that it is going to be women always who advantage of them.

(*Mr Price*) Not only single male scientists take advantage but also married males. Our most successful crèche at the Babraham Institute started with 20 places and now has 60 places including an after-school play scheme. Many people using it are in fact male members of staff, perhaps to help their wives to work elsewhere in the science base possibly.

(*Professor Blundell*) One of the things we have learnt is that if one asks "How many crèche places do you need?" you come up with ridiculously small figures but if you put a creche in place, it is full up within a very short time and there are calls for expansion. The opportunity really opens up new horizons for people.

(*Mr Price*) We also find today that there are a number of very good private sector operators providing managed creches, so that you do not have to go into it as an employer setting it up from your own resources. You can, in fact, get in a management consultant effectively to set up a creche and run it on a management fee basis, and that works very well.

574. A little earlier you did say that you not only expected quite a number of these contract staff would not continue in academe but would go into other posts, some of them in industry, and you did mention, or at least it was in your paper, that you had a scheme for assisting the transfer of getting people into other jobs. Would you like to tell us a little more about that?

(*Professor Blundell*) I should say that is not an implemented proposal but it is an idea we are considering.

(*Mr Price*) It is an idea which we derived from the European Commission's Human Capital and Mobility programme, where three-year bursaries were available for fellows to return to the less developed scientific communities in Southern Europe. That idea appealed to us as an idea for helping the companies that do not have experience of employing post-doc scientists to take somebody on at a limited risk to themselves. It has been developed as a possible idea which could be looked at more generally across the system, not just in BBSRC.

575. How far has it got?

(*Mr Price*) At the moment we are suffering from the constraints in the expenditure of which Professor Blundell referred earlier. Within our Research Committees we are looking at a number of options, including the fellowship schemes, with a fairly limited budget to spend. So I think the likelihood of its getting off the ground on any scale in the next year or so is quite limited.

Lord Craig of Radley

576. Would one of those schemes be something like the Daphne Jackson fellowship scheme? We have had written evidence suggesting that there is a window of opportunity now for research councils to get together with the Daphne Jackson.

(*Professor Blundell*) I am a trustee of the Daphne Jackson Trust.

577. You can probably tell us exactly where you stand on that?

(*Professor Blundell*) I have only recently joined but yes, of course, the BBSRC has been talking with the Trust. Their schemes are exactly what we should be running. There are opportunities for doing this jointly with the trust.

578. But this is taking its place along with a number of other ideas which Mr Price has mentioned, so it has not yet become a firmly adopted Research Council scheme?

(*Professor Blundell*) There are a number of factors that we have been considering with respect to improving careers in science. At the postgraduate level we ask whether we are paying stipends which are sufficiently great in areas of competition to attract the best students and to make post-graduate training an attractive opportunity. We are looking at the longer-term fellowships, five-year fellowships that can move with the individual. We are looking at bring-back fellowships of the Daphne Jackson type. We are also looking to see what extra funding we

[Lord Craig of Radley *contd.*]

require in order to give a broader and more professional training at all levels, both the postgraduate and the post-doctoral. At the moment we have a careers panel reviewing these options and looking at them against our funding profile for the next few years.

579. But presumably the outcome of that, if widely publicised, could be an important element in encouraging students to think that science as a career is being well looked after and well managed?

(*Professor Blundell*) I agree, but we have a very clear idea of what we would like to do but there are, of course, restraints from limited funds available to implement them.

Chairman

580. Before we leave this particular aspect, there are just two points we have not touched on. One is question 5. Do you think there is any scope here for nationally agreed and enforced settlements in relation to making the position of the contract research staff better, both in the short term and also in the long term in the sense of career development, or do you think it is better left to the institutions themselves to work out with their own employees? The other point I would like to ask about is whether you have any information on whether any people are leaving this country, obviously not to the advantage of the country when they do leave, because of the unsatisfactory nature of the contract research situation? I should add that we are making enquiries in the United States of America where, interestingly enough, they have a very similar situation to ours, what they call the "gypsy" scientists moving around. I would be very grateful if you could tell us on these two specific points whether you think there is a place for national agreements or not, and secondly, on the question of whether there is, in fact, an actual "brain drain" because of this present contract research situation?

(*Professor Blundell*) My Lord Chairman, on the question of national agreements I think there has to be one. It has to bring with it the full support of the research councils, the Office of Science and Technology, the universities and the AUT. I think it is perhaps less relevant to the funding councils, who are not specifically involved in management of careers. Such an agreement is the objective of the concordat, to agree on national standards. I am not sure it needs to be enforced by law. But research councils, of course, have the right to ask the institutions we are funding what they have done with respect to encouraging career development.

581. Have you exercised that right already?

(*Professor Blundell*) We have not specifically but with a concordat, we will be in a position to refuse to consider an institution for funding if that agreement is not followed. With respect to your second question I refer to my own experience as a researcher and to my own research students. Many of them do go to the States. Indeed about half of my graduate students have gone to the States. They go into a "gypsy" environment but the perception is that the opportunities are greater in the States.

Baroness Platt of Writtle

582. Do they come back?

(*Professor Blundell*) Some do but many less than I would have expected. There was a period of time, about ten years ago, when none of my post-doctorals came back. That is no longer true. A number have come back; I have just appointed one to my research unit, who has been for three years in the States.

583. That would be valuable then?

(*Professor Blundell*) That is very valuable.

Lord Phillips of Ellesmere

584. There seem to me, my Lord Chairman, to be two sides to this problem. The first is that a research leader of Professor Blundell's quality is bound to instil in his students the thought that this is clearly the most noble and excellent career to which one could aspire and they will, therefore, seek to continue in the model to which they have been brought up. I doubt if there is even in Professor Blundell's lab a great deal of discussion of the rival attracts of being a school teacher or maybe going into industry and so on. To do these things arguably is seen as a failure. The other side of problem is to what extent does industry come forward and say, "These are exactly the sort of people that we need." I should have thought that situation was better in the bio-technology industries at the moment than it has been in some industries. Is that your view as well?

(*Professor Blundell*) It is certainly my view. Research from the London Business School and the Economic and Social Research Council shows that interactions between the science base and industry are tremendously variable. If you look at the clustering of small companies you find in biology they cluster with research institutions, but in computing they cluster with other parts of the industry. Research funded by the Economic and Social Research Council shows that most information which the bio-based industries obtain comes from the science base. Before I took on my present job I had five or six people in my research group funded by different industries, we have sold a lot of software from academia and my research team I do not think quite coincides with the model which may be general elsewhere. I have research staff in Glaxo, Wellcome, Roche and many other companies, almost every pharmaceutical company in the country and certainly many of the post-doctorals that have been employed in my laboratory by industry have moved from that position into industrial jobs. There are examples in Fison and Glaxo, for example, in the last two or three years. I think in some laboratories there is an awareness of the opportunities in industry and certainly in the research underpinning bio-technological and pharmaceutical areas there is a great degree of awareness that there is an opportunity there. I think the difficulty comes when you go beyond the research environment. Indeed, the research environment in many pharmaceutical companies and bio-tech companies is extremely exciting and not all that different.

Chairman

585. But not easy for astronomers and particle physicists.

(*Professor Blundell*) No, much more difficult for them. You find people moving areas. There are several people I have had who have started off as biologists and ended up in computing companies. There is an opportunity to move if you have a vision of what to do. But the problem is of course in terms of school teaching, in terms of other jobs in management in companies, then I think there is less of an understanding of the opportunities and there is probably less of an opportunity as well.

Lord Haskel

586. Is that why you say that employers have a "weakly formed perception of the value of highly trained scientific staff"?

(*Professor Blundell*) I would not apply that to everyone. In the science-intensive industries, the pharmaceutical industry, the bio-technology industry, the agro-chemical industry and the chemical industry they have a very good perception of the importance of scientifically trained staff. But in many small and medium sized enterprises—for example in the food industry,—there are very few post-doctorals employed. There is then a problem of not only the awareness that PhDs might be useful but also a general technology awareness problem. One of the things we have done in the new council is to set up three directorates where we have involved members of the different kinds of industries to bring them into the planning process and to try to map their market-led objectives on to new scientific opportunities. This is important for defining funding priorities for our own programmes but it is also important for networking academia with industries of various kinds. One of the problems is one of numbers. In the food area, for example, one has over 3,000 small companies that could use science or technology. We have 300 or 400 people working in the food research area. The problem of technology inter-actions and technology awareness is a difficult one.

587. Thank you very much. We have limited time I am afraid and we have not touched on the question of the Master of Research degree. I wonder if you could tell us what progress you have made. It is now just about a month, I think, since you advertised your nine courses. Is there any up-to-date information on how that is going?

(*Professor Blundell*) It is properly monitored so we have the latest statistics and Bob will give them to you.

(*Mr Price*) In your papers, my Lord Chairman you will find—

588. The new paper, thank you, we have not had time to read this.

(*Mr Price*) I will take you through it; it is very easily summarised. There is an analysis there of the position as of yesterday in our nine pilot schemes. On the left-hand side is the number of enquiries received about the Master of Research degree; the second column is the number of applications, which is blank in many cases because none have been received as yet. Then there is for the purpose of comparison the number of enquiries and applications received for MSc courses or PhD courses in the same university departments. We want to get a feel of how that might be a guide for the popularity of the Research Masters Degree.

589. I am not sure I understand what the third column of figures is?

(*Mr Price*) That is the number of applications and enquiries for PhD places and MSc places in the same departments.

590. How can you have more applications than you can have enquiries?

(*Professor Blundell*) The enquiries are just for the Masters.

591. These are for PhDs and MScs, I see, I beg your pardon. Thank you very much; that is very helpful. Do you think it is possible when another couple of months have passed and we have not finished our work to update this and give us the figures which then apply when presumably some of the enquiries will have become firm applications and the universities are going to have to make decisions as to whether they are going to proceed with these courses.

(*Mr Price*) I think they will proceed, my Lord Chairman. I think one issue which we are monitoring very carefully is whether the Research Master degree is, in fact, a second best option, ie, the student applies for both the PhD and the Master of Research and if they do not get the PhD they will take the MRes because that is better than nothing. We want to monitor that carefully at the point of entry. We have designed a questionnaire with the other research councils which will be given to all the MRes applicants this year. This will give a cohort analysis as at 1st October 1995 which will carry on through to the end of that academic year. A further analysis at the end of that year will let us know whether they proceed either to a PhD or to industry or somewhere else.

592. Will you have any information which provides us with pointers to show which way it is going by the end of May?

(*Mr Price*) Yes, most certainly.

593. That would be very helpful if you could.

(*Professor Blundell*) We see the Masters degree as a new idea that has to be tested. We are supporting it strongly but we need to analyse it to see how successful it is. Its attraction has to be in a better professional training which gives new opportunities to graduates. We can only test that by carrying it out.

594. That will be in a sense in terms of subsequent employers assessing these people probably five years down the road.

(*Mr Price*) Not necessarily. If the first graduates go into industry rather than carrying on with a PhD we will have a snapshot in about a year's time.

595. You will not know what their performance is like in industry; that is the point.

(*Mr Price*) We will get some feedback from employers about their initial reactions to their qualifications, background and training and so on.

(*Professor Blundell*) Different industries have very different requirements. Indications even from the pharmaceutical industry are not entirely uniform because Glaxo had a different view from many

[Lord Haskel *contd.*]

others. It seems that many of the bio-technology companies are looking for a professionally trained PhD scientist. That is certainly the evidence that we have received but I think the experiment is certainly worth trying.

596. I think it will vary a good deal from subject to subject. Thank you very much for coming. May I just ask in conclusion whether there are any points which we have failed to elicit that you would like to put before us which are not in the papers which you very kindly gave us today, which we shall study with care?

(*Professor Blundell*) I do not think so, my Lord.

Chairman: Thank you very much indeed for coming, Professor Blundell and Mr Price.

Supplementary Memorandum by the Biotechnology and Biological Sciences Research Council

The attached Appendix provides the additional information on costs of maternity/childcare provisions requested by the Select Committee when we gave oral evidence last week. A full financial calculation of costs and benefits would include any capital, maintenance and running costs associated with nursery/playscheme/after school care provision, and the reduced recruitment costs associated with a lower rate of staff turnover.

Unquantifiable costs and benefits include the ability to attract and retain a wider range, and higher quality, scientists, and the loss of momentum in research during maternity leave.

We would, of course, be happy to provide any further information which the Committee might find useful.

Appendix—Estimated Costs of Maternity Provisions—1994–95

1. UNIVERSITY CONTRACT RESEARCH WORKERS EMPLOYED ON BBSRC GRANTS

Assumptions
1,316 Research Assistants (RAs) on grants
658 technicians on grants
50 per cent of RAs are women
9.1 per cent of women RAs will have live births (figures supplied by OPCS)
6.3 per cent of women support workers have live births (figures supplied by OPCS)
100 per cent of women RAs are age 25–35
RA has more than 26 weeks service
RAs salary costs = 46 per cent of the grant
Average grant award = £135,000 over three years
University provides 13 weeks maternity leave on full pay to academic staff
(RAs are employed on academic staff terms and conditions)
100 per cent of RAs taking maternity leave take full 18 weeks
Support workers salary = 18 per cent of the grant
50 per cent of grants employ support workers
University provides statutory maternity provision (SMP) to support workers

Gross maternity pay costs (average)	£5,437
(of which reclaimable)	£2,557
Net cost per women	£2,880
Aggregate annual net cots (60 cases)	£172.8k
2. Abeyance Costs (pa)	£84.1k
3. Maternity costs for support workers (pa)	£2.5k

4. BBSRC Institute staff

Maternity leave on full pay for 18 weeks

Assumptions
86 staff will take maternity leave each year (based on figures supplied by OPCS and data from PERFAST)
All staff have more than 26 weeks service (qualifying service)
Average salary = £13,000 per annum
100 per cent of staff taking maternity leave take full 18 weeks

Gross maternity pay costs (average)	£4,500
(of which reclaimable)	£1,821
Net cost per women	£2,679
Aggregate annual cost (86 cases)	£230.3k

5. Research Fellow's

Maternity leave on full pay for 6 months placing
grant in obeyance

Assumptions	50 per cent fellows are women
	The rate of maternity incidents is 9.1 per cent
	All fellows take six months leave
	Average salary = £20k

Budget is £2.4m per annum

Additional cost is 50 per cent (women fellows) of 50 per cent (six months) of 9.1 per cent (maternity incidence) of budget

$\frac{1}{2} \times \frac{1}{2} \times .091 \times £2.4m = £54.6k$ per annum gross

The statutory element is reclaimable. Net cost £51.2k per annum.

TUESDAY 21 MARCH 1995

Present:

Craig of Radley, L.	Howie of Troon, L.
Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Dixon-Smith, L.	Redesdale, L.
Haskel, L.	Renwick, L.
Hilton of Eggardon, B.	

Memorandum by the Medical Research Council

EXECUTIVE SUMMARY

The traditional career structure for academic scientists has many strengths. The use of short-term appointments in the immediate post-doctoral stage provides an appropriate environment in which young scientists can assess for themselves, and demonstrate to potential employers and the scientific community, their suitability for the exceptional demands of longer-term careers in research or academia. In the medical and biological sciences, there is in general no shortage of career openings (taking into account all employment sectors) for those who in this early period of their work show a talent for research—although opportunities within the narrower sphere of academia have been limited. Nonetheless, there are real shortcomings with the structure which must be addresed, not least so that it is no longer perceived as unsatisfactory and therefore a deterrent to young scientists contemplating a research career. These shortcomings concern the management of young scientists during the "apprenticeship" stages of postgraduate study and immediate post-doctoral work (in particular to avoid unrealistic expectations about career openings) and the availability of routes through which the transition to more secure or longer-term openings can be made.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

1.1 In presenting this evidence, the MRC assumes that the inquiry is concerned with the traditional career structure for scientists in UK universities; this comprises firstly a number, commonly two or three, short-term contracts each of perhaps two to three (sometimes five) years' duration. These are regarded as the apprenticeship for longer-term or "permanent" academic posts which combine research and teaching responsibilities; those successful in reaching this stage would be aiming for more secure positions in their thirties.

1.2 The MRC is well-placed to comment on the problems and advantages of this structure: not only is this the structure within which MRC-funded university research is undertaken, but a similar structure underpins the staffing of its own Institutes and Units.

1.3 The problems inherent in this structure in the universities are due to four main factors:

(i) It is heavily-weighted toward the junior end of the profession: the growth in the numbers of contract research positions since the early 1970s has not been matched by significant growth in the career outlets within academia. For those who remain in contract research positions, the career structure fails to deliver much recognition of accumulating scientific seniority; postings continue to be short-term and awarded in competition with new scientists entering the field, and add little experience to make post-holders attractive to other employers;

(ii) The transition from short-term positions to more senior posts is difficult to achieve, in part through a lack of intermediate opportunities to demonstrate the very high standards necessarily required of candidates for more permanent academic positions, and partly because advice to individuals on their career development at this critical stage is generally patchy;

(iii) The career structure fails to afford young scientists any security at a time during which they are seeking to establish their careers and may be taking on in parallel non-work responsibilities—this may present particular problems for women scientists;

(iv) The structure leads to institutions devoting considerable energy and resources to recruitment and training of staff who may be retained for only limited periods and whose loss at the end of contracts may prove disruptive to the creativity and progress of university research teams. It is questionable whether contracts of less than about three years provide significant training and development;

1.4 As a consequence of these problems, there is very widespread dissatisfaction in the career structure for scientists in universities. On the other hand, university research provides one of the nation's most important training environments for research, and the health of the scientific base therefore depends on these problems being addressed.

1.5 MRC experience in its Institutes and Units is that this career structure can provide a very satisfactory basis for recruitment, retention and motivation of high calibre staff—including maintaining a steady rate of returners from overseas. This success is achieved partly by ensuring that there continue to be more senior and secure opportunities within the MRC for outstanding young scientists, and partly through careful selection, training, appraisal and career guidance from MRC supervisors, so that unreasonable expectations of careers within the MRC are not built up and help to identify other career openings is given. These have enabled the MRC to capitalise on the distinct advantages which the career structure offers:

(i) the flexibility to use resources to support the best scientists emerging from postgraduate training. And the flexibility to resource priority areas of science and redeploy funding as appropriate;

(ii) the encouragement of mobility within the scientific community at this critical stage in career development; skills and techniques are transferred, exchanged and developed;

(iii) an appropriately demanding apprenticeship for the inevitable challenges of a research career.

These are major strengths in the career structure and should not be lost.

2. *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

Question addressed above.

3. *How do you expect the situation to change in the next decade? (Please bear in mind, among other factors, the current age structure in full-time university posts and expected changes in university income levels and sources).*

3.1 Universities and research funding organisations in general seem to share a commitment to work towards overcoming the problems. As *Realising Our Potential* emphasised, responsibility rests primarily with the universities as the employers, but funding bodies have an important part to play given the key contributions which contract research staff and academic scientists play in their meeting their own objectives. The MRC is working on two fronts to this end.

3.2 Firstly, the MRC is increasing the proportion of funding to university research which supports longer-term and personal forms of support for academic scientists. This will improve the number and range of opportunities for outstanding scientists to work in university research at the intermediate and senior career levels. The schemes now available for the personal support of scientists pursuing research careers are as follows:

Non-Clinical	*Clinical*
Research Fellowship 3 Years Post-doctoral research experience (around 10 per year)	**Clinical Training Fellowship** 3 Years Post-registration to Senior Registrar or equivalent (around 55 per year)
Career Development Award 4 Years (Opportunity to spend up to 1 year abroad) Further post-doctoral experience consolidating skills (around 10 per year)	**Clinician Scientist Fellowship** 4 Years (Opportunity to spend up to 1 year abroad) Registrar / Senior Registrar with PhD (around 10 per year)
Non-Clinical Senior Fellowship 5 + 5 Years Independent scientists, team leaders (around 8 per year)	**Clinical Senior Fellowship** 5 + 5 Years Senior Registrar / Consultant (around 2 per year)
Research Professorship / Readership (Rolling tenure)	**Research Professorship / Readership** (Rolling tenure)

3.3 Secondly, the MRC wishes to work in closer partnership with universities to ensure that MRC funding is utilised as effectively as possible for the career development of high calibre contract research staff, and not just for the pursuit of excellent science. To this end, the MRC is pressing universities, where they have not already done so, to provide more effective career management and advice for contract research staff. It has also been working with the other Research Councils, in consultation with the Royal Society and Office of Science and Technology, to draw up a statement of the expectations of the Research Councils in relation to the management of contract research staff by the universities, and the obligations which the Research Councils have in the partnership. It is hoped that discussions with the CVCP will begin shortly.

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

4.1 The MRC has not systematically obtained these data in the past, although it plans to do so as the necessary information systems come on-line as part of the current implementation of the MRC's information Systems Strategy.

4.2 A limited survey was undertaken between 1989 and 1992, and provided the following analysis of first destinations of contract research staff employed in MRC establishments. It should be noted that these restricted sample findings are not necessarily applicable to university-based contract researchers:

1. UK university/NHS etc scientific research	27 per cent
2. Non-European (primarily US/Australian) laboratories	35 per cent
3. UK-based pharmaceutical companies	7 per cent
4. European (non-UK) laboratories	10 per cent
5. UK scientific administration	3 per cent
6. Other Research Council employment	4 per cent
7. Unemployed	7 per cent
8. Unknown/other	7 per cent

5. *What should be done to improve the mobility of scientists between academia and industry?*

The increasing recognition of the contribution which research can make to wealth creation, and in particular, the present interest in the exploitation and commercial application of academic research, can be expected to generate practical opportunities for secondments and exchanges between academics and industry. Schemes which encourage closer collaboration between industry and the publicly-funded science base, such as "Realising our Potential Awards" (ROPAs) will also make an indirect contribution to this. The challenge for the employers is to provide the necessary enabling mechanisms for greater mobility when opportunities such as these present themselves, and the MRC is currently working on plans in this area. One example is the decision to extend the existing Senior Research Leave Fellowship scheme to enable "permanent" academic scientists to spend time in industry and *vice versa.*

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

6.1 There are approximately equal numbers of women and men currently holding MRC Research Studentships and studying for PhDs, and it is therefore difficult to conclude that in our sector of science there are any significant problems with the perception of *science in some form* as a career among women. Within MRC establishments, the proportions of women fall in more senior grades of research worker, although the proportions have increased over the past five years. Our conclusions are that the lack of senior women in the biological and medical sciences, though not as extreme as in other areas of science and engineering, is due in part to historical factors—now working through—and in part to genuine difficulties in pursuing a postdoctoral career in research.

6.2 Discussions within MRC establishments on this matter have suggested that a range of factors are perceived as obstacles to career development for women in scientific research. These include:

— the culture (long hours, male networks etc)

— the insecurity and mobility during the immediate postdoctoral phase

— the conflict of managing two careers in a partnership/marriage

— the pressures arising from the conflicting demands of work and parenthood

— general perceptions of self-esteem, ability to cope and compete etc.

In order to make progress it is important to know whether these problems are faced solely by women, and/or are unique to science. The MRC is supporting some academic research in this area by a member of its staff, and is also joining Opportunity 2000 so that it can draw on the experience of other organisations in tackling these issues.

6.3 In the meantime, it is clearly desirable to dismantle artificial obstacles to women seeking research careers. In the MRC, we are for example currently reviewing maternity entitlements specifically in relation to short-term contract staff in our establishments, and we are pressing universities to extend the maternity leave facilites enjoyed by permanent staff to contract researchers if this is not already the case and are prepared to fund grant extensions to compensate for maternity leave. To facilitate the management of career demands in relation to non-work responsibilities, *providing scientific success is not jeopardised* all research appointments funded by the MRC may now be held part-time (subject to a sensible lower limit) and Fellowships are portable. Schemes for awards are designed to ensure that they do not discriminate on grounds of age and thus present an obstacle to individuals who have taken career breaks. A further area which should be tackled to improve women's perceptions of career possibilities is that of establishing role models for younger scientists to follow. Opportunities must be taken to raise the profile of senior women scientists. Efforts are therefore made to ensure that an appropriate balance of male/female representation is maintained on MRC's peer review bodies.

7. *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

The MRC supports the need to look more critically at arrangements for management and assessment of PhD students, and at the employer-relevance of PhD skills and content. However, we did not support the introduction of compulsory Masters courses as the solution in all circumstances. The MRC is piloting a small number of Research Masters courses from October 1995, in areas which harmonise closely with the Council's strategies and priorities. Mechanisms will be put in place to ensure that this new approach to postgraduate research training is carefully monitored and evaluated. The Council had favoured piloting a broader more structured 4-year PhD although we accept that these would not have been appropriate in all areas. However, these plans have now been put on ice following the Government's decision not to encourage four-year PhD's.

Examination of Witnesses

SIR DAI REES, Secretary, DR DAVID SMITH, Director of Human Resources and DR DIANA DUNSTAN, Director of Research Management, Medical Research Council, called in and examined.

Chairman

597. Thank you very much for coming and for your very interesting memorandum. I do not know how you think it would be best to organise this part of our meeting with you, whether you would like to go through your own memorandum or through the questions because we shall try and make sure all the questions are covered, but there are some points which come up in your memorandum which are not covered by the questions. Before we begin, is there anything any of you would like to say by way of introduction?

(*Sir Dai Rees*) Thank you, Chairman. If I could just make a few brief remarks because there are just some simple points we would rather like to highlight. Can I first introduce my colleagues: Diana Dunstan on my far right and David Smith. Diana is Director of Research Management and David is Human Resources Director at the MRC. I think the first point that I would like to make is to draw attention to our long experience of running research institutes and research units which means that about half of the technically trained people who are doing research funded by MRC are actually on our own pay roll, the other half being in universities. We like to think that these institutes and units have been rather successful and continue to be rather successful. That success we believe is due to, of course, the calibre of the scientists that we have been fortunate to attract and employ and maintaining a research environment which is attractive to this part of the nation's best scientists is of the highest priority to the MRC. As part of this, we keep the subject of your enquiry in the forefront of our minds in everything that we do because the whole success of the enterprise depends on this. The experience of being exercised by this preoccupation has also helped us to learn a lot over the years about the challenges of recruiting and developing people who are likely to make a successful research career and also some experience of how to handle in a humane and responsible way those people who are not going to make successful research careers. So the input we have made and the comments we will make in these discussions are based upon quite a solid body of experience. That is really the first point that I would like to make. A second point: as your Lordships have described it, the nomadic apprenticeship which young scientists experience is certainly very tough but we think that it is essential in order to prepare scientists for the exceptional intellectual demands of a research career and also as a testing experience through which the best demonstrate that they are equipped to deal with the demands of a research career. We believe that the science base will be weakened if there is any relaxation in the rigorous training which scientists undergo at this stage in their careers. In fact there was a period in the 1970s when jobs were chasing people rather than people chasing jobs when there was such a relaxation. I think we live to regret the consequences of that. On the other hand, we also agree that it is not good enough to expect young scientists to sink or swim in this tough environment. It is only defensible to maintain this environment if those embarking on a research career are helped to demonstrate their abilities and helped to get the best out of the training that is on offer. In other words, if they are provided with help and advice and mentorship with their career development so that those with talent or valuable skills have access (which, of course, means equal access in the case of women) to career opportunities in sufficient numbers. With the growth of numbers entering the profession as contract researchers in the universities, and perhaps the difficulties for their employers of providing the necessary career development support which I have stressed is so important, we have witnessed a gradual discrediting of the scientific career structure in the universities. Though I have stressed our own experience as employers, I have emphasised that it is only a half of the people doing medical research funded by the MRC who are directly employed by us, which means that the environment and the development of researchers in the university sector, what we call indirect support, is just as important to MRC as that in our own establishments. So that we are very grateful for this opportunity to discuss these issues with you.

[Chairman *contd.*]

598. Thank you very much. Has Dr Smith or Dr Dunstan anything to add?

(*Dr Smith*) No.

599. Can we get a few facts clear and get on the record a clear understanding of the position. You said, roughly half of them are what you call indirect, let us say, contract staff in universities, the others are in-house.

(*Sir Dai Rees*) Yes.

600. Those who are in-house you can manage very easily, those who are out-house or indirect it is difficult.

(*Sir Dai Rees*) Yes.

601. Do you not have any influence on the employment of those who are the contract staff of the universities or are you kept at a distance in the sense that you award a grant to a university and then it is up to it to employ the individual on terms?

(*Sir Dai Rees*) Traditionally we have kept our distance because we thought that was the right thing to do. I dare say we would have been kept at a distance had we attempted to get closer. Increasingly now we are trying to get closer and to work in partnership with the universities, and we have got various exploratory discussions under way in that direction.

602. Of these groups I noticed you had some figures which were in tabular form in Section 3.2 which made a distinction between clinical and non clinical.

(*Sir Dai Rees*) Yes.

603. Can you tell us of your totals what proportion are non clinical and what proportion are clinical?

(*Dr Smith*) I will try and answer that, my Lord Chairman. In the MRC units among our directly employed staff, and thinking about academic scientists rather than technical staff, it is about ten per cent who are clinically qualified.

604. I see.

(*Dr Smith*) Among those people supported by MRC grants in universities it is about the same proportion, perhaps slightly less than ten per cent clinically qualified.

605. If we just look at this table I ask myself the question if the clinical training fellowship is for three years, and you have had 55 a year, that means at any one time there are something like 165 of those and when I look at what happened as one goes up the age range, which is going downwards on the table I assume?

(*Dr Smith*) Yes.

606. A lot of that 165 must drop off.

(*Dr Smith*) Yes.

607. Do they go to practise clinical medicine and is that the distinguishing feature from the left hand side of the table?

(*Dr Dunstan*) Most of them, yes.

608. Are they then lost to research except for that which they can find time to do as part of their job, as it were?

(*Dr Dunstan*) I think, my Lord Chairman, they have had a good experience in research and they may well contribute, for example, when they put their patients into clinical trials and in that way but not in a laboratory sense.

609. Do they find themselves generally in particularly distinguished research led hospitals, shall we say, or are they distributed around the country?

(*Dr Dunstan*) By and large I would say that ones which have our clinical training fellowships stand a very good chance of getting good jobs in research led hospitals.

610. I know a lot of them at RPMS but that is the only one with which I have close contact. So really the patterns for the two are quite distinctive?

(*Dr Smith*) Yes.

611. When you come to look at the destinations on the facing page—perhaps we could clear up some of this—are those people who are in that group one to eight which you surveyed, in the first category of non clinical or clinical or are they mixed?

(*Dr Smith*) Perhaps I could answer that. These will be all non clinical. Perhaps I should explain that this information was included as the only quantitative information we could provide on this particular question of destinations of post docs when they left the MRC. It results from a survey at one of our research institutes.

612. These are in-house people?

(*Dr Smith*) These are in-house people, yes.

613. The staggering thing to me was if you sum up item two and item four, 40 per cent of them appear to leave for US, Australia or European laboratories but earlier on, I think in 1.5, you say you have "... a steady rate of returners from overseas...". They are in this group, are they?

(*Dr Smith*) They are indeed. The people who are included in these figures are the sort of people who will later return to the United Kingdom, in our experience will come back to the United Kingdom.

614. Most of them?

(*Dr Smith*) Yes. This week, in preparation for today, I had a look at the previous employment of a number of people who had come back to one of our institutes into either career scientist positions or what we call career track positions, that is five year appointments, and over half of those people were United Kingdom citizens who had gone to the States to do post doctoral work.

615. So it is a normal progression for a non clinical medical research scientist?

(*Dr Dunstan*) To have a period abroad, yes.

616. When they come back what kind of posts do they come to, permanent posts or temporary, have you any idea?

(*Dr Smith*) A mixture I think.

(*Sir Dai Rees*) It would depend on the stage of their career.

617. The young ones temporary?

(*Sir Dai Rees*) The young ones temporary and the more established ones permanent.

618. So if they go into the university they get into the queue of the contract staff?

[Chairman *contd.*]

(*Sir Dai Rees*) Or increasingly within our own establishments we have a cadre of what we call tenure track appointments which are five year appointments which provide the opportunity for them to demonstrate what they can do on their own under some mentorship. The Royal Society Research Fellowships, of course, are the same kind of thing.[1]

Baroness Hilton of Eggardon

619. Forgive my ignorance, there have been several references to training and training being excellent. Within most people who have short term research grants, they do not get in any way a formalised training. Do I understand that under your clinical training fellowship there is actually a formal training system? My experience of research and the experience of my friends of research is that it is rather haphazard what you learn?

(*Dr Dunstan*) When people put forward applications for training fellowships we ask about the general training environment of the department and specific things that they are going to do. It is part of the assessment procedure. We have to say that a lot of the training is, as it were, on the job because you are learning the job but there are additional things that can be done and indeed we encourage people to do. That is part of the assessment of the application as they come in.

620. Do you check up afterwards that people have learned specific things or not?

(*Dr Dunstan*) We visit training fellows regularly and I think that is the sort of thing that comes out in conversation with MRC officers. In future we propose to follow this up in the final reports on the fellowships and indeed also on the final report on our grants to find out more about the training that has been given to the people who are employed on grants.

621. If there is formalised training that is all part of what we would hope to be a formalised assessment and career development package people have without that formal structure.

(*Dr Dunstan*) Yes.

622. It is difficult to assess how people perform.

(*Dr Dunstan*) Yes.

Lord Dixon-Smith

623. Lord Chairman, I am fascinated that we appear to have what I would call twin track systems, on the one hand medical research institutes and on the other hand you have the universities. I wondered if, because the two systems are dramatically different, different patterns of career development clearly arose like this business of non clinical researchers going abroad? Do they tend to do that more from one side of the business, shall we say, than the other? Does it tend to lead to a greater proportion of one side arriving at the top of the chain in the end or is one side of the business more vulnerable than the other in that respect?

(*Sir Dai Rees*) I think it would be a weakness if we allowed a polarisation to develop between these two careers. It is, in fact, a conscious policy of our's to integrate units and institutes into university activities. The salary structures of those employed by us, by MRC, are in fact related to the universities, we use the university pay model, and people move between the two sectors particularly at senior level from units and institutes into chairs. Very often, or not perhaps as often as we would wish but not infrequently, a promising university research worker will be taken on to our staff, will become a unit director; or a half way house is to give an MRC senior leave fellowship where he temporarily becomes a full-time researcher. So the two careers are blurred and linked and we hope symbiotic with each other.

Chairman

624. Would it be true to say that your in-house work represents, as it were, your staple, steady projects which are going on over a long period of time whereas in the university field you tend to put your money on people more than on particular subjects you want to see developed? I noticed that you have gone in for really longer term appointments to a considerable degree and that suggests that you are backing people.

(*Sir Dai Rees*) Well, we back people on the basis of their proposals and I suppose their track record. In these days where (and in my view rightly, perhaps explicitly since the White Paper) research council are more on more taking on the responsibility of fostering research which meets targets or goes in directions that are agreed with Government, obviously it is much easier to do this with people who are on your own pay roll than it is at one stage removed from the universities. So there is probably a larger community of medical researchers in the university sector who would consider themselves following their own interests, their own interests in isolation perhaps is a strong word but apart from whatever the interests of MRC are, than there is in our own institute or units.

625. They are generated by the individual but they fit in broadly with what you would want to see done?

(*Sir Dai Rees*) Some of our funding, the minority it has to be admitted, is given to grants which are rated purely on the grounds of excellence.

Lord Craig of Radley

626. You, Sir Dai, and indeed others have stressed the importance of the mentor's role in developing the young scientist and encouraging them.

(*Sir Dai Rees*) Absolutely.

627. That leaves one to ask whether there is a need or whether in your case you have a structured mentoring arrangement in the sense that an individual knows that he is a mentor for a youngster, that he has been given some guidance as to what sort of mentoring subjects he is to cover. Because it seems to me it can be either left fairly haphazardly to

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[1] MRC's experience is that few "returners" would take up contract research positions, but would obtain longer-term or "permanent" posts.

[Lord Craig of Radley *contd.*]

normal individual motivation to help or it can be given a more structured group arrangement.

(*Sir Dai Rees*) Yes.

628. I would be very interested to hear your views about that and indeed whether you have taken that thought into a practical arrangement.

(*Sir Dai Rees*) Yes. We do very much take it into account in reviewing our units and reviewing rolling programme grants. We think it is important that this be carried into the heart of university grant funding activities so that there are two things that we are introducing. I do not know whether either of them will have an earth shattering effect but just an example to illustrate how important we think it is, we are trying to send a message out to the universities that we will consider applications for five year grants rather than three year grants if part of the case is based on the fact that that grant is going to be used for the development of a named promising contract researcher. Indeed, if the grant proposal not only describes the work that is going to be done but lays out why it is a good thing for the career development of this person then we will try and make sure that our Grants Committees take that into account and gets it recognised. That is one thing. The other thing is the importance of role models. I think mentors and role models are obviously two issues which are quite linked. This is why we are planning to expand the number of MRC research professorships. The numbers here are rather negligible on the table. I think we need many more—we have to see what we can afford—MRC professorships and also not just professorships who are perceived by young to sit on some unattainable pinnacle but also readerships and intermediate positions, to plant in the university sector people who are progressing their careers through achievement in research and not through the mixture of achievements that determines normal university progression. Those two things we are trying to use to push the principles of mentorship and role models.

Chairman

629. Are you expecting the universities to follow that leadership with their contract researchers generally to manage their incoming money that way?

(*Sir Dai Rees*) Perhaps we could say a little bit about the negotiations that you have had with university administrations and also the code of practice and so on, David?

(*Dr Smith*) My Lord Chairman, we are tackling this by two different routes. Firstly, about a year ago we started to talk to a number of the universities—six or seven universities which are the ones we invest in most heavily—about these issues to find out the extent to which they shared our view that contract researchers perhaps were not looked after well enough and that a lot of benefits would flow from better management within the universities of the sort of people who are supported on MRC grants. We had very encouraging signals from those discussions and they have led into a series of seminars which we are now right in the middle of with the same universities, talking to the senior principal investigators as well as the university management about these issues, again with favourable results, certainly support from the universities for the principles we are discussing. Those discussions have been very helpful to us in participating in a small group, which no doubt your Lordships heard about from the OST representatives, which is being set up under OST chairmanship with the other research councils and with the Royal Society to see what the scope is for a sort of concordat with the universities which would set down minimum expectations for how contract researchers would be managed. We played a major part in drafting the concordat which is now being discussed with the CVCP and we will be drawn, no doubt, into discussions about the implementation of that over the next few months.

630. Do you expect to make a statement about this in the foreseeable future?

(*Dr Smith*) I think it will be for the OST to make the statement on that.

631. When, have you any idea?

(*Dr Smith*) I am not certain of the timetable, Chairman. Certainly informal discussions are already under way with the CVCP so it ought to be a matter of months at the outside I would have thought.

Lord Howie of Troon

632. Looking through your paper, it seems to me that you approve of a system in which young scientists have a number of relatively short term appointments before they get into their thirties.

(*Sir Dai Rees*) Yes.

633. You see this as a period of apprenticeship—the word you used—it could also be seen as a period of uncertainty. What makes you think that a period of uncertainty is likely to produce better scientists rather than anxious ones?

(*Sir Dai Rees*) I think by definition the scientists we need are self-starters and I believe that almost all the young scientists (that I have had to deal with that had a considerable degree of promise) wanted was the opportunity to take their own future into their own hands and decide what they are going to do, how they move around from problem to problem and subject to subject. I think the uncertainty, as you describe it, can also be seen as a freedom.

634. Let us just look at that. What self-starters do is move about as you have just described but they move about under their own volition.

(*Sir Dai Rees*) That is right, yes.

635. That volition is removed under this system, they move about at somebody else's volition when a short term contract comes to an end. It is a funny kind of freedom.

(*Sir Dai Rees*) I think maybe we need to distinguish between different types of people.

636. Sure.

(*Sir Dai Rees*) If we are talking about the principal investigators of the future, the high flyers, I think I would say that there is not a great deal wrong with the system that we have. I think where it goes wrong is where principal investigators, who need a pair of hands on the ground to do a bit of research,

[Lord Howie of Troon *contd.*]

encourage individuals to accept a limited contract in the unrealistic belief that it will lead on to something else beyond it—which it will for the good but which it will not for the not so good. I think that is where it needs tightening up.

637. The important thing you said was that the system goes wrong.

(*Sir Dai Rees*) Yes, by lack of career guidance.

Lord Phillips of Ellesmere

638. Can I pursue that point a little, Sir Dai, through a slightly different route? We do talk a great deal about the importance of producing the principal investigators and leaders of the future. As you have just said these people in general depend upon teams. There is indeed an argument that even in your sort of science, science has become much more a mass production system than it was, say, in our youth, in projects like the human genome programme, for example, let me say, in structural biology even, one depends upon some leaders and a number of people who are experts in particular techniques to carry it on.

(*Sir Dai Rees*) That is right.

639. What have you got to say about the continuing provision in these support staff? I would imagine they are a mixture? Are they sometimes support staff who will always be support staff? Are they sometimes people on their way to becoming principal investigators going through a period of being support staff? How do you see that developing?

(*Sir Dai Rees*) There is a second category, I agree, of support staff and it is important to provide career structures for them as well. Of course, in our units, in our institutes, we have done this and I think it is very important to be quite clear about what sort of role an individual is expected to carry out and how he is paying his way. I think in more feather bedded times there was a number of individuals around our system who were at the level of hewers of wood and carriers of water and providers of services and doing experiments and so on but not providing the creative thrust of the work who were masquerading as principal investigators. I think that is not so true now but it is important, as you say, in teams that those people are recruited and employed and recognised for what they are. I would claim that we do that in the direct side. Also it is important to do that in the universities and perhaps a third example of a development that we are embarking on, that I should have given in answer to Lord Craig's point, I hope will go some way towards this question. Now, it is a fundamental weakness of a research funding mechanism which gives out money or support in three year packages that it cannot fund people like this on a continuing basis. Perhaps I should add it is a problem—although I know you are very familiar with it—which is exacerbated by the transfer of money from the university funding stream on a continuing basis to pay the full costs of research projects but only on a three year basis. For this reason we feel that we have to do something. The best idea we have had so far, I think, which we are beginning to implement, is to go to a university department or a group of departments where research activities are such that they will be expected to provide continuing employment for particular skills or particular disciplines of support staff and say to them: "Now, we are not going to guarantee that any particular three year project grant is going to be renewed, you must take your chance. But we the MRC are prepared to take account of the fact that out of the ten or 12 projects which are going on in parallel under different principal investigators in the space of any one time there are always going to be well between eight and 15, let us say. Therefore if you will undertake the responsibility for looking after this person's career development and assure us that he is not going to get specialised out of existence then we will provide a career post for him under the scheme which we call "infrastructure grants". These are set up to provide career appointments of the support type I have mentioned and also equipment that might be shared and maybe bricks and mortar as well.

640. This is in a way inclined to help universities to get used to living with short term grants with no absolute continuity?

(*Sir Dai Rees*) That is right.

641. To provide permanent structures to support staff?

(*Sir Dai Rees*) That is right, to provide a platform.

Chairman

642. This must be easier for you because you said you were dealing with six or seven universities which are obviously those which are larger and have a large research income so they are able to have a margin which does not exist in smaller institutions or in other subjects?

(*Sir Dai Rees*) It is like the reinsurance game, is it not, the risk spreading game, the Barings' business; the risk which attaches to a career appointment on any one project grant is going to be spread around.

643. What you are seeing by these natural processes, in a sense, is that research will tend to be more and more concentrated in what might be called -for want of a better term—research led universities, and that is particularly true in medicine. Can you tell us, since of course MRC is only one provider but you know about the other providers, the medical research charities, are they performing in a similar way to you? Are they acting towards universities similarly? We have heard, I may say, from the Wellcome Trust and they seemed to share your view about looking for individuals.

(*Sir Dai Rees*) Yes.

644. Do you think most of them do this because together they provide such a lot of money they must be a very powerful influence?

(*Sir Dai Rees*) There is quite a considerable similarity in philosophy in these matters between ourselves and the Wellcome Trust. There are some differences in the way actually we do things which derive in part from the fact that we have this very long history of experience of being an employer whereas it is only now that they are becoming a major funder—comparable in size with us—that they are having to face that issue. So I think they are still

[Chairman *contd.*]

working things out although moving very much in the right direction, if I may say so.

645. One point which has been made about these contract research staff, even though they may be there, is that they are relatively disadvantaged to people of the same age and similar qualifications and experience who are—and I put this in quotes nowadays since tenure has gone -"on the permanent staff of universities".

(*Sir Dai Rees*) Yes.

646. Do you try and match your salaries with the appropriate clinical, NHS or university academic staff grades?

(*Sir Dai Rees*) Yes.

647. In all cases?

(*Sir Dai Rees*) Yes.

648. So you have not encountered this problem?

(*Dr Smith*) I think the only thing, if I may add to that, is that we are aware, amongst contract researchers in some universities, of a feeling of being somehow not part of the university, that neither the university nor the funding body responsible for their salaries are quite taking the interest in them that an employer normally would. One of the things we have been saying to the small number of universities we have been talking to, and also in the context of the OST discussions on this concordat, is we would expect contract researchers to have all the privileges that members of—as your Lordship put it—permanent staff have within university. It is not helpful for there to be a barrier between the two.

(*Sir Dai Rees*) The big problem, is it not, is the number of what might be called no hopers that they allow to hang around the system. Really it is a very depressing experience to go—as I have done—to certain universities and sit with a couple of dozen contract researcher workers and say: "What are you going to do when you have finished" and they say: "I am going to try and get a lectureship".

Chairman] This is particularly bad for women but I think Lord Craig wants to ask you something.

Lord Craig of Radley

649. We have concentrated a great deal on handling the scientist when he is in the system and highlighted a large number of problems and how they might be addressed. Of course we have got to start off by getting them into the system at the beginning. We have had a variety of different views expressed to us on this ranging from "Well there is very little unemployment in immediate post PhD so obviously there is a good take up" to others who suggest that many bright scientists who could make a great showing in research are put off by some of the sorts of problems which we have been discussing earlier. I would be very interested to hear your reaction and your views on the problems or otherwise of getting people into research?

(*Sir Dai Rees*) I think it is a feature of our times that if we want a fair share or the right proportion of the best young brains to come into science and into scientific research then we have to compete with a number of other types of employment. I have the impression that the employment possibility for people with a science degree has opened up a lot more nowadays than it was. There never was any choice for me really, it was quite clear which direction that I was going in. If you are reasonably near the top of the class then you go into the next class and so on, which I think was a weakness. It is good that we are getting very capable scientific minds into other areas of employment. Still we have to look after the interests of the scientific enterprise. I think the way to do this is to make research attractive and there is a number of ways in which you can do this. Very interesting that we were talking, when we were stationary in the taxi, about the experience of an inter-disciplinary exercise that we started between University College London and King's College London a few years ago called the MRC Centre for Molecular Cell Biology which is an intentionally multi-disciplinary centre which looks at problems of neuro science, of basic problems of cell architecture and cell structure and a variety of different aspects all within one roof. Here is a centre where if bright young people have been turned on and excited by anything in their first degree they will have been turned on and excited by something in this general area. David, you might like to mention, this is advertising PhDs which will provide a broad exposure to this area and the specific research project in one area. The kids are flocking in. I think if there are research centres which are clearly doing something exciting which are well equipped and are buzzing and a reasonable level of student stipend is provided, then we will get them in. David, do you want to say anything?

(*Dr Smith*) A piece of information from the Director of the PhD programme there, they offer five places a year on a four year PhD which starts with one year giving the students an opportunity to rotate between three or four short projects. They had 80 applicants this year all of whom were rated as outstanding applicants. Many straight "A"s at "A" level originally and from the country's best universities. That is a measure of the competition for this place.

Lord Phillips of Ellesmere

650. If we go back, Sir Dai, to the people you described as no-hopers, of whom I have in my day seen a number, do you think one of the problems there is the very fact that there are multiple sources of funds these days for medical research? It does not really make all the difference if you turn them down as possible research assistants, there is the whole range of medical research charities and industry that their supervisors will turn to in order to be able to retain these pairs of hands. Is that the way it works?

(*Sir Dai Rees*) I do agree, and there is no external quality control on the appointment of people to these. Once the money has come for what might be a very good or worthy research budget there is no quality control on who has filled the post. I think the universities have to be encouraged to exercise that quality control. For example, one of the things which emerged in one of our discussions at one of the universities was the thorny question of bridging funds, where you have somebody who has finished one project, there is another one coming up, you

[Lord Phillips of Ellesmere *contd.*]

want to keep him around. We said that MRC would provide bridging funds if we were sure that it was a good career development thing to do, and the university volunteered by saying, "I suppose if we identify those individuals who did not have a career in research then you might believe us when we said these are the individuals which do have a career in research." A number of universities are beginning to actually move in that direction and it is very encouraging to see. There is no harm in saying the University College deserves some congratulation on this.

Chairman

651. Yes, we have been there to talk to them.

(*Dr Dunstan*) It does underline the need for career development and counselling-through, and it also underlines I think the need for the low flyers to have a perspective on the other kind of jobs they could take up. One of the things we have been thinking about and talking to these universities about is whether in fact they might like to come to us and ask, if they have someone who really needs to get out of research and into other jobs, towards the end of the grant would we be prepared to let them have two or three months' work experience in another field as part of the career development of the person on the grant. If they ask and indeed put up a good case for it, I think that is something we would be perfectly prepared to do.

652. I noticed in section 5 you did refer to the fact that you were rather helping people out, as it were, and if you would like to supply us with any further information on this scheme we would be very interested to know about it, accepting of course you do have a kind of specialised industry. But there is one subject we have not yet touched on which we would like to get your views and I am conscious the next group of witnesses has been waiting for some time, and that is the so-called Master of Research. Is the MRC involved in any pilot experiments in this context? Have you formed any views before relating to that experience? Have you any general observations and wisdom you can pass to us?

(*Dr Dunstan*) The MRC's view is that on the whole the users we have do not favour a Master of Research. The pharmaceutical industry on the whole is not looking for that kind of person. We had asked people to put in proposals for a four year PhD system. However, that was obviously ruled out and we are now following up—

653. Obviously ruled out?

(*Dr Dunstan*) By the OST.

654. It is also more expensive per PhD produced?

(*Dr Dunstan*) Yes.

Lord Haskel

655. Why "obviously"?

(*Dr Dunstan*) I am not sure of their reasoning.

(*Sir Dai Rees*) I think we should say it is well-known a policy decision was taken that there would not be a four year—

Chairman

656. At the end of the day it is not in the hands of the OST however much they speak it, it is in the hands of the universities?

(*Sir Dai Rees*) Yes, but as far as Research Councils' funding is concerned. For example the Wellcome Trust in partnership with universities is free to do other things and I understand they are going to.

Chairman] Yes, they are.

Lord Phillips of Ellesmere] My Lord Chairman, a four year PhD is not more expensive than an M.Res followed by a three year PhD, which is not ruled out.

Chairman

657. No. Both of them on a fixed sum of money of course reduce the number which emerge at the end, do they not?

(*Dr Dunstan*) We had about 40 applications for four year PhDs and we invited ten of them to come back with an M.Res proposal, for two reasons. Firstly, because their four year PhD proposal seemed to lend itself to an M.Res year; there would be the opportunity to have that and then to go on to do a PhD. Secondly, because they were in areas which particularly fitted our scientific strategic objectives; we now have those applications and by the end of this month we will be taking decisions on which ones to fund.

658. Within this new four year arrangement is there special provision for specific research training?

(*Dr Dunstan*) Yes. It is formal training with a project.

659. So in fact it will be sometime, five or six years, before you can begin to assess whether these are valuable?

(*Dr Dunstan*) That is right.

(*Sir Dai Rees*) As I understand the reasoning for the M.Res, there is meant to be a clear discontinuity with many, if not most, of the individuals going into it actually going off to something else and not continuing with the PhD. So in fact in a couple of years' time we will be able to see to what extent it is producing that kind of product.

Lord Craig of Radley

660. A final but very important issue. In your section 6 you give a good deal of information about how you see problems for women, if there are some, and you employ more or less equal numbers. You give us some very helpful bullet points as to reasons why there may be problems. One point which has been brought up with us more than once is establishing crèches. I wonder if you would yourself see it as inevitable that your Council will have to put its hand in its pocket to help with this in order to ensure that we do get back into the system highly qualified women scientists who have still a very big contribution to make?

(*Dr Smith*) Some MRC establishments already have access to crèche facilities for their staff, and those are being used. All have the opportunity to say whether they think it would be useful to set up their

[Lord Craig of Radley *contd.*]

own. The fact that most MRC establishments are located on university campuses means they do tend to have access to crèche facilities provided by the university or others in that particular location, so the MRC itself has not yet been asked to set up a crèche at all. If that was indicated then the opportunity is there to do it.

(*Sir Dai Rees*) Dedicated MRC crèches would appear in very few locations.

(*Dr Smith*) Exactly.

Lord Phillips of Ellesmere

661. The difference between you and the BBSRC in that case must be the BBSRC has more free-standing institutes, so to speak?

(*Dr Dunstan*) Yes, in more isolated sites.

Chairman] I think we must draw this to a conclusion, because we are heavily over-running time. I would not like you to feel you have not had a full opportunity to make any points to us, so if there are any which you perceive we have not touched on and you would like to put in another memorandum, we would be very happy to receive it. I am sorry you have been so badly treated.

Memorandum by the Institute of Physics

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

The major problem is that there are many outstanding research workers who aspire to university posts, but not enough permanent academic positions for them. Allied to this problem is the perception (confirmed by the Institute's biennial salary survey) that levels of pay for academic scientists in the UK are not competitive with those of other professionals. In addition, there are difficulties in obtaining funds for research. For these reasons many of the best up-and-coming scientists look outside the UK to continue their careers.

2. *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

It can be argued that the growth of short term research contracts gives flexibility to the execution of changes in scientific policy eg the Engineering and Physical Sciences Research Council and its predecessor SERC, have had a series of initiatives in recent years in low dimensional structures, magnetism and non-linear optics and the speed with which these programmes could be implemented and eventually phased out was heavily dependent on the support of fixed term contract post-doctoral research assistants.

Another advantage is the increased opportunity for training research workers beyond the PhD for posts in research outside the universities. The Institute believes that a period of post-doctoral research in university is for many an important part of professional training.

Short term research contracts enable good people to be supported for a limited time but this is no substitute for a proper career progression.

A disadvantage is that the increased number of fixed term post-doctoral positions means that a decreased proportion can make the transition to an academic career. Although it is important to maintain and improve the quality of academic appointments there should be more applicants than jobs, if the ratio becomes too large researchers will become disillusioned.

In some cases, short term contracts from industrial sources do not provide the opportunity for proper long term development of particular research topics.

Although there is an advantage to tenured senior scientists in the availability of an inexpensive research resource, this is often countered by the short period of effective output obtained between the new researcher learning the work and shortly after becoming pre-occupied about the next job move. The availability of grants for specialist projects and the availability of well qualified candidates in those areas often do not match.

3. *How do you expect the situation to change in the next decade?*

The present age profile of academic staff in physics departments presents a serious problem for the future of physics. The problem has been well documented in the report produced for the Science Board of SERC by a committee chaired by Dr Derek Roberts, Principal of UCL, and subsequently in the IMS study Science PhD's and the Labour Market. These studies show that, unless there is a significant increase over the current recruitment rate of physics lecturers, there will be a dramatic decline in the permanent academic population over the next decade.

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

As far as the Institute is aware, the only published data on the first destinations of research assistants appears in the Institute of Manpower Studies report referred to in the previous section. The sample of physicists in this report is too small to make any strong statements about destinations of contract researchers. The Institute of Physics is in a position to follow up the careers of its 21,000 members over time, in so far as it has at least yearly contact with them. The Institute is willing to collaborate on such a study with other bodies (eg PPARC and EPSRC).

5. *What should be done to improve the mobility of scientists between academia and industry?*

The first point the Institute should like to make regarding mobility between academe and industry is that it should be established at undergraduate level. Agreements need to be fostered between industries and universities which include a range of joint activities eg undergraduate projects and industrial fellowships linked to specific research and development projects. Collaboration could also include input from industrial physicists to teaching.

In order to succeed there need to be perceived benefits for both industry and universities to cooperate. For a research academic to be attracted to take part in an industrial project requires an incentive such as access to specialist facilities. Also it would be attractive if the opportunity were provided to do science that cannot be done in university. However, at a time of considerable job insecurity industrial scientists may well be nervous to participate in exchange schemes. Allowance should be made in promotion criteria for time spent in the alternative institutions.

Thought also needs to be given to the mechanisms of funding such schemes. If they were considered to be a priority, funds should come from government as well as universities and industry, some of which may be provided in the form of tax incentives to industry.

Schemes of this nature should involve small as well as large companies. Indeed one can argue that small companies should be a priority.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

The proportion of women in physics (excluding astronomy) at undergraduate level amongst students domiciled in the UK has increased from 16.1 per cent to 17.7 per cent in the period 1989–90—1993–94, according to data published by The Universities' Statistical Record. At postgraduate level the proportion of women has risen from 11.8 per cent to 15.8 per cent.

In the same period the proportion of women tenured academics in physics wholly funded by universities has stayed constant at just over three per cent (c.f. 17.6 per cent across all disciplines). In this period the number of women at senior lecturer level and above has risen in absolute numbers from four to eight.

From these figures one can see that there is an upward trend of participation for women at undergraduate and postgraduate level although the trend is slow and the proportions are way below parity with men. We would be disappointed if this upward trend did not continue.

The major difficulty for many women is the combination of career and family. Short-term contracts make this far worse as they are awarded at a time when women are most likely to be thinking about starting their families.

Improved creche facilities at universities would enable more women to return earlier than they would otherwise. Clarification is needed on whether maternity leave is available for researchers on fixed term contracts and who pays for it. This issue needs to be advised by universities, Research Councils and government. Fellowship trust funds such as the *Daphne Jackson Memorial Fellowships Trust* should be generously supported to enable women scientists to return to work after a career break. The possibility of working from home, job sharing and other flexible working patterns should also be encouraged.

The Institute endorses the recommendation made in the report *The Rising Tide* of the committee on Women in Science Engineering and Technology that research funding be made more flexible so that potential award holders are not disadvantaged if their mobility or availability for work is restricted by family commitments. The Institute also endorses initiatives where "portable" fellowships are awarded to individuals rather than to institutions so that the holder can choose his or her place of work.

Finally the Institute would like to see the removal of age restrictions on grant applications. This would be to the benefit of women and men who have taken time out from their careers to fulfil family commitments.

7. *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

The Institute has argued that the MRes degree is not the best qualification for professional physicists. The MPhys and MSci degrees are a preferable preparation for PhD students. We attach our response to the consultation on MRes as a summary of our position (*not printed*). We would like to state our continued concern that the *limited* pilot undertaken by EPSRC, if not funded separately, is likely to divert existing funds for PhD studentships away from physics.

Examination of Witnesses

PROFESSOR SIR ARNOLD WOLFENDALE, President and MR P DIAMOND, Higher Education Manager, Institute of Physics, called in and examined.

Chairman

662. Good morning, Sir Arnold and Mr Diamond. Thank you for coming. We have your memorandum in front of us and you have the possible questions. This does not in any sense restrict us, it was meant to be a help to you as to what might be expected. Is there anything you would like to say at the outset which is not in your papers to lead us into the subject?

(*Professor Sir Arnold Wolfendale*) Thank you, my Lord. I would like to start by saying a little about the Institute of Physics. I realise, my Lord, you are a chemist but nevertheless—

663. Which is the queen of the sciences!

(*Professor Sir Arnold Wolfendale*) We have 21,500 members which is quite a significant membership amongst the physicists of the nation, and of course a few abroad. About 20 per cent are within the university sector and about 35 per cent are within the industrial and public sector area. So we do straddle the two sides, if we can put it that way. We are very mindful of some of the problems, in fact all the problems your Lordships are examining, and we are delighted to be able to help.

664. Thank you very much. Mr Diamond, do you want to add anything?

(*Mr Diamond*) Nothing to add, my Lord.

665. Looking at your memorandum and also bearing in mind what we have had before, we get the impression that the problem in the universities is really quite a severe one at the present time, partly because there is really little mobility or at least movement out of the system in the top age groups, but that will come in ten years' time, and that means there is a bottleneck in making appointments at the lower end, therefore everybody getting older and staler perhaps, and the universities are getting a lot of their research done by a vastly increased number of research staff—in the last 15 years there has been a four-fold increase, which is very significant. Within that, of course, many of them are on repeated short-term contracts. Can you tell us whether the position in physics seen from the Institute's point of view is very similar to that overall in the sciences?

(*Professor Sir Arnold Wolfendale*) I think it probably is, and I think the main difficulty is that everything stems from aspiration. It seems to me, and I think this view is shared by the Institute as a whole, there are too many young people in the university system who aspire to stay in it forever and we, let's face it, are failing by, I would not say pandering to that but, helping to generate that. In other words, there needs to be a sea-change in attitude, that a university education in physics and indeed other subjects should be equally in preparation for industry or commerce as well as in preparation for university research and a permanent job in the university system. If that were the case and we could arrange that, more young people would go into industry, would see that as a first career, a priority career, and not as it tends to be at the moment as second best.

666. Are you speaking here of first degree graduates or post-docs?

(*Professor Sir Arnold Wolfendale*) Both, I think. I would hope the post-doctoral training would also be commonly seen as a preparation for industry or commerce.

667. Who should be responsible for giving the advice and are they capable of it?

(*Professor Sir Arnold Wolfendale*) I might say I am not sure as to the first and I need not answer the second. I think the responsibility is widespread, not least within universities and not least within industry too, because I think industry (in fact I am sure) does not make the careers in industry sufficiently interesting, sufficiently exciting, alas, to attract some of these very bright people. As you know from your own experience, I am sure, my Lord, the majority of young researchers will stay on into middle age if they can manage to get soft money after soft money after soft money in the hope they will eventually get a permanent job. This is very bad in all sorts of ways, not least because when, as you say, in ten years' time (in fact it is starting already) the retirement bulge really starts and universities start to appoint, the odds are they will go for the very bright, young ones and not the 35 year olds who have been kept employed all these years.

668. So all those 35 year olds really should have been advised earlier on?

(*Professor Sir Arnold Wolfendale*) Yes.

669. Say, at about 30 at the latest, to look elsewhere?

(*Professor Sir Arnold Wolfendale*) Yes, absolutely.

670. And given some indication earlier on as to whether they were likely or unlikely to gain a university appointment?

(*Professor Sir Arnold Wolfendale*) Yes. I think the remedy in part is in our own hands within the university system. If one reads the White Paper, as we do, and I realise some of your Lordships were concerned in the preparation of this, there is a stricture there that universities should take this on board and universities should advise research

[Chairman *contd.*]

students, research fellows, research associates and so on. Perhaps at this stage I could ask Philip Diamond to say a little about a particular experience he had in a university, a big university not very far from here—he need not name it—and he can tell us the results because it seems this is not happening, the university supervisors and others, I am afraid, are still not saying this to the youngsters.

(*Mr Diamond*) Yes, we went to a large physics department in London, and there were about 55 participants in this seminar which occurred last week.

671. Was it on a technical subject?

(*Mr Diamond*) The seminar was purely about the issues this Committee is concerned with. We did a little questionnaire, we had 30 questionnaires back. Of those questionnaires, 16 were from post-docs, three-quarters of whom aspired to a permanent position at the university still, and three-quarters of those had no advice on a career move from that department.

672. And they were discontented, naturally?

(*Mr Diamond*) Indeed we asked that question. Half of them were content and half of them were not content!

Baroness Hilton of Eggardon

673. I wanted to posit the opposite scenario to taking the bright young people rather than the 35 year olds. My experience of career planning is that there is often misplaced sympathy and loyalty for people who have been in positions a long time, and therefore the tendency might be to take the less bright people who have been around for a long time, and that is particularly dangerous for science and is another consequence of the lack of proper career planning. I do think it is important to realise that selection boards or whoever may operate that way because somebody in their mid-30s is married with children and there are all sorts of reasons for wanting to give them the permanent job rather than taking a good scientist, and that is a concern.

(*Professor Sir Arnold Wolfendale*) If I may add, Chairman, I think the problem relates to a remark you made when the previous people were here, that is the university's job. The universities are a law unto themselves, but somehow we have to get it through to the universities they have this responsibility to people. Wearing a different hat as a researcher myself, still despite being retired from a university, it is a marvellous thing having young research associate fodder who will do my research for me, but someone has to tell me to ensure this person gets good advice and so on.

Lord Haskel

674. Could I ask Mr Diamond whether at the university he visited the task of the careers department at the university was also seen to be helping to give career advice to the staff as well as the students, or was it purely students? I understand at some universities now the careers department is working with the staff and trying to give the careers advice you were saying was lacking.

(*Mr Diamond*) I think that is a problem. Mainly they would be concerned with under-graduates, I would think, and clearly the under-graduates outnumber the rest, so their hands would be full with trying to give those people adequate career advice. They would not see it as their job, I would imagine although I cannot say this for certainty, they should be giving careers advice to post-docs.

Lord Renwick

675. Following on from that, could you tell us the proportion of females and males who answered your questionnaire? It would be interesting to have details of this seminar which was purely, as I understand it, on the subject of this enquiry?

(*Mr Diamond*) Yes.

Lord Renwick] Perhaps a report would be of great interest to this Committee.

Chairman

676. Indeed.

(*Mr Diamond*) We can certainly supply that.

677. And any others you may carry out.

(*Professor Sir Arnold Wolfendale*) Might I just interject here? I appreciate your desire for information but I am a little worried about the role of the IOP, that it has this informal seminar and gets all these facts in and then the next thing is that the House of Lords gets the information and our name will be mud and Philip Diamond may never be seen again, if this big university in London has its way!

678. He does not look very ephemeral to me! I think he will survive. I do not think one need worry about that.

(*Professor Sir Arnold Wolfendale*) Thank you.

679. This is a natural point I think at which to talk about the second subject which we have here, industry and academia. You say it is necessary to establish mobility at the under-graduate level, the Institute is doing something actively in this sphere but you feel the universities are not advising students at that level. You also say that smaller companies are a priority in this, small and medium sized enterprises, to use the jargon. Why are they so important? Is it because they are regarded as the mainspring of economic growth or is it because they are under-represented as employing physicists?

(*Professor Sir Arnold Wolfendale*) I would not say that, quite. What I would say is that I think the need is greater in the small companies because obviously they have not got the superstructure to deal with these things. I think the big companies of tomorrow are some of the small companies of today, and if we are to get growth we have to get more small companies into the big company bracket. That is really all we meant there.

680. The trouble about small companies is that they either do not have the resources or are unaware of the opportunities and the gain they can get from employing a well-qualified and capable physicist.

[Chairman *contd.*]

(*Professor Sir Arnold Wolfendale*) Absolutely.

681. Does the Institute do something about that? You have an industrial committee, do you not?

(*Professor Sir Arnold Wolfendale*) Yes, we have a number of industrial committees and we have this corporate affiliate scheme where a number of companies actually belong to the Institute. I must say they are the big ones in the nature of things at the moment, but this is something we are very, very keen on.

Lord Haskel

682. On this question of small companies, do you have a system whereby small companies can in fact borrow physicists for a short period of time, or is there a way that they can become aware of their need for them? I agree with you entirely, this is the problem, but there are quite a number of schemes of exchange, of learning of this sort of thing. Do you encourage them?

(*Professor Sir Arnold Wolfendale*) Yes. The IOP is endeavouring to encourage that and indeed is producing a database of physicists and their skills which will be circulated to the smaller companies. Over and above that one has the links between individual universities and colleges and local companies where this is done on an every day scale.

683. Equally it is important that small companies should improve their recruiting skills so they can recruit a suitable kind of person?

(*Professor Sir Arnold Wolfendale*) If we wish these small companies to progress, yes, absolutely. That is why, my Lord, we mention here the desirability of introducing an industrial dimension into university work even at the under-graduate level. Of course it comes back to the original remark I made about changing the ethos of post-graduate and under-graduate education, because it is very shocking that such a small fraction of highly trained physicists go into industry. It is not peculiar to physics of course, there are a number of hard sciences under-represented.

Chairman

684. It is very markedly different from chemistry and always has been. I am not quite sure why, other than the fact that the work a chemist does when he goes into industry initially at any rate, and may be for at least three years, is very similar to that which he would have done had he stayed on at university as a bench chemist before he does other things. Is that not the case in physics?

(*Professor Sir Arnold Wolfendale*) It tends not to be. Certainly chemistry courses are regarded in universities as more vocational courses whereas a physics course tends to be rather broader, with respect—

685. Did you say "respect" or "disrespect"?

(*Professor Sir Arnold Wolfendale*) It is up to you, my Lord! No, with respect. I was not saying anything negative about chemistry but we seem to get youngsters coming into physics—I keep calling them youngsters, I hope that is not patronising, but what else can you call young people?—young men and women who want to go into commerce or go into areas where numbers are important and with respect, again, I would suggest physics is a better route than chemistry for that. It is rather more quantitative very often. Also, which I think is very important, young people with an altruistic attitude want to be extended in some exciting, vibrant area of science, and physics, particularly astronomy, comes into this. So we get young people coming in to do the astronomical component of physics courses in the full knowledge they will never come in contact with it again but, particularly if they have done a PhD, they will feel they have contributed to mankind's knowledge about the cosmos, and that is a marvellous thing.

686. But of course they have to earn their living, so they do need guidance at some stage?

(*Professor Sir Arnold Wolfendale*) Exactly. I agree, that is where the guidance comes in.

687. Should the responsibility for that be with the university and the head of department? Do you think it is lacking at present?

(*Professor Sir Arnold Wolfendale*) I think it is lacking and I think it is everyone from supervisor upwards. I think perhaps the supervisor is the key person in this because we must face it, it is the supervisor who so often gets the credit for the research that is done in the research area by young people. So I think they have a crucial role to play.

688. But then that supervisor gets a grant from the research council and starts employing contract research staff and keeps on the good men, so the supervisor is tugged in two directions, is he not? That helps to create the problem?

(*Professor Sir Arnold Wolfendale*) Yes.

Baroness Hilton of Eggardon

689. Can I interject and say you cannot have guidance without a proper system of assessment?

(*Professor Sir Arnold Wolfendale*) Exactly.

690. So much of the assumption about whether people are good or not is subjective, and you do need some structure of assessment before you get on to the career guidance and advice and so on, and what seems to be lacking generally throughout the world of science research is any system of assessing which people are good, partly because it is a team effort of course.

(*Professor Sir Arnold Wolfendale*) Perhaps the research councils should play a role in this in providing this guidance, but they would have to be guided in the first instance too that this might be the route to follow. In other words, what I am saying is that grants would only be given to those supervisors who in addition to showing excellence in their research agreed formally to provide this guidance.

Chairman

691. One point which stands out about physics, which is different from the rest, is the small proportion of women who both enter at the under-graduate level and then go forward, and for reasons

[Chairman *contd.*]

of time constraint or maybe other reasons very few of them then go on to the permanent staff of the universities.

(*Professor Sir Arnold Wolfendale*) Yes.

692. Is there a lost resource there? Should one be pressing the case for recruiting women just because it is a resource of ability and also giving equal opportunities to them, or is the whole phenomenon part of an over-production of scientists generally? That is what an external observer might say.

(*Professor Sir Arnold Wolfendale*) No, I think we are missing our way through not doing enough to help women. In fact the Institute of Physics has recently formed a group devoted to women in physics and they are pondering mightily over this question of why we are where we are and how we can get from here to there. As I see it, it is the "Meccano for little boys" syndrome, which starts at a very young age.

693. It is a kind of social pressure on women not to go the route of boys?

(*Professor Sir Arnold Wolfendale*) That is right.

694. That is certainly borne out to the extent in mixed schools the proportion of girls who go in for physics and science generally is less than in single sex schools.

(*Professor Sir Arnold Wolfendale*) Yes.

695. Where, I suppose, the pressure is removed?

(*Professor Sir Arnold Wolfendale*) Yes. We are very alive to this problem, hopefully.

Chairman] That is a problem we cannot influence, at least not under our terms of reference.

Lord Renwick

696. I wonder whether Sir Arnold has given thought to the fact that physics involves a lot of computers, a lot of IT, and that perhaps women are not so comfortable with that as men? Is that his experience?

(*Professor Sir Arnold Wolfendale*) With respect, my Lord, I should disagree. I would have thought in many ways women were more comfortable and more attuned with interacting with inanimate matter. What I mean is that the social pressures which come with the interaction between men and women are absent if one is interacting with a device.

Chairman

697. May we move on a little to those students who, having graduated, then, as you say in your evidence, "tend to look outside the UK to continue their careers"? Is this on a temporary basis? As you may have heard in medicine, many of them tend to go abroad for post-doctorates but also many of them return. Is that the pattern in physics?

(*Professor Sir Arnold Wolfendale*) To some extent it is, it is not clear in fact. Talking to many who have gone, they were not clear when they went whether they wanted to go permanently or not, but it is true that some come back. The reason for their going in the first place is interesting and it comes back again to this ethos of academia being the be-all and end-all. You get bright young people who cannot get an immediate job on the university staff, instead of saying, "Industry is equally exciting and important, I will go there", they say, "No, I want to follow up this work I am going on quantum chromo dynamics come what may, and if I cannot do it here I will go to Stanford or Brookhaven." This is what we have to try and break, this very early polarisation.

Lord Phillips of Ellesmere

698. Partly referring back to an earlier part of the discussion, I would have said that immediately post-war and for perhaps 40 years after that, physics was actually an extremely popular public subject with a great amount of public support for it, and the distinction between that and chemistry was that the chemical industry was still essentially a private industry but vast numbers of physicists were employed in public agencies like Atomic Energy and so on. That affects perhaps people from particular areas of science, but the point I want to come to is this: post, should I say, the alleged end of the Cold War that sort of government interest in physics-based activities has certainly declined and in my view will decline further. Does this sort of thinking penetrate at all into the education of physicists? Do they notice that the United States did not go ahead with the super-conducting super collider? Do they notice the scope for astronomers in this country or abroad is diminishing rather than increasing? That sort of thing?

(*Professor Sir Arnold Wolfendale*) Lord Phillips is endeavouring, as he sometimes does, to goad me particularly with the last remark about astronomy!

699. I will leave out the astronomers, if you like.

(*Professor Sir Arnold Wolfendale*) Those who think seriously about these matters do worry about the syndrome you have identified. They do not worry too much about the SSC because I really do not think that the reason for the Americans not going ahead with the SSC was related to the end of the Cold War and that side of things.

Lord Phillips of Ellesmere] I suspect, if I can interrupt, my Lord Chairman, that had the Russians still in the Cold War situation been going ahead with a super-conducting super collider of that kind the Americans would not have held back.

Chairman

700. It is not necessary for you to comment on that statement!

(*Professor Sir Arnold Wolfendale*) Lord Phillips is entitled to his view. I worry more, joking aside, about the astronomical side and about the whole area of space research. It is true there that the end of the Cold War has diminished the need for so much work. However, I would hope that the pure scientific dimension would still carry a lot of weight and although there may be somewhat of a reduction—and of course we can talk about the European Space Agency and its problems if you wish—I would have hoped we would have flattened out quite soon. I do not know whether I have answered the question and perhaps we are getting away a little from the tack. The point you did make about the public attitude in

[Chairman *contd.*]

your remarks was a very important one, and as your Lordships will know I am chairing a group looking into public understanding of science from the standpoint of the extent to which mainly young men and women in universities who are going out to educate the public to help them understand science are in fact trained to do so, and that comes back to your point. It is one thing saying, "Things should be done", it is another making sure it is done properly. I think now the onus is on the scientific community to get out there and tell the public what a marvellous job we are doing and how they should provide support and lobby Parliament or whatever to make sure that adequate science is done.

701. This is the week in which to say it, is it not? May I ask a question? I think you said you had over 20,000 members. Presumably you have a computerised register of them?

(*Professor Sir Arnold Wolfendale*) Yes.

702. That would enable you to break down the occupations of the physicists into various categories—industry, what kinds of industry, academic and so forth. I think it would be very interesting to have what I would call an anatomy of British physics which would help us to see what happened to physicists and how that illuminates the points you have been making.

(*Professor Sir Arnold Wolfendale*) Can I say we are doing just that. We have just started and we are in the process of producing with other groups a questionnaire for all our members to try and get at their career profile, because this is one thing the universities cannot do, usually, unless they have tabs on everyone because they want to get money from them every week or whatever. The IOP is perfectly placed to do exactly this. I think we owe it to the community, and as Lord Phillips implies, physics is in a bit of a difficult spot for one reason and another and we shall do that.

703. When would this be available?

(*Mr Diamond*) Six to nine months.

704. We have covered quite a lot of territory. Are there any points we have failed to elicit from you which you would like to bring to our notice, other than that which is in your paper and its annexe?

(*Professor Sir Arnold Wolfendale*) Mr Diamond has mentioned the magic phrase M.Res. I am afraid I go in the blue in the face when M.Res is mentioned!

705. We shall try and resuscitate you if that becomes seriously damaging! It was the last point I was going to ask you about, as a matter of fact. We know the chemists by and large do not look forward to it as a possibility, they tell us their students are very anxious after graduation to get directly into research and they do have training on the job. They do not foresee, and nor does the Chemical Industries Association, that there is a particular value in this. Can you tell us what the situation is in physics?

(*Professor Sir Arnold Wolfendale*) Rather similar, but perhaps not quite as strong. I feel, and I think many members of the Institute feel, that some of the elements of the M.Res are very necessary and could, and indeed should, be incorporated into Masters degrees of more conventional form, but I really do not feel a full year devoted to this sort of activity is warranted; it is very general research training. However, it is true that communications skills need imparting. This comes back to the under-graduate as well as the post-graduate area, and the nature and attractions of industry and all these other dimensions which educated scientists ought to know about. They should be taught but they will have to be taken seriously, these mini courses will have to be examined, otherwise we are wasting our time and we will be back to the French for physicists or German for physicists of 40 years ago, which no one took seriously.

706. In 1977, when I was Chairman of the University Grants Committee, when I proposed to a number of university engineering departments they might consider a four year under-graduate course containing elements of an understanding of physics, technology, economics, how you manage people, I was surprised by the outcome of that, that the seven universities which started this immediately began to cream off the first-rate people who were applying to universities for engineering, and that movement has grown. Are you arguing, and I think you did argue at one point in your document, for four year under-graduate courses which would contain this element?

(*Professor Sir Arnold Wolfendale*) Yes, in the fourth year.

707. Would you make it general or would you give it the special cachet of a masters rather than a bachelor degree?

(*Professor Sir Arnold Wolfendale*) I would have thought just a four year degree. Of course I realise the funding problems and so on.

708. Has the Institute developed any policy on this?

(*Mr Diamond*) There was a report published in 1990 which did recommend four year under-graduate degrees for a proportion of the cohort.

709. This was an Institute report?

(*Mr Diamond*) The Institute along with the body representing university physics professors and heads of polytechnic departments, which at that time were separate of course. So it was a three body report. We recommended these four year courses for a proportion of the most able and committed students who intended to become professional physicists either in the university or in industry. Those courses are now being offered and in fact from 1993 they do have the designatory title of M.Phys or M.Sc, Master of Physics or Master of Science, but they are distinctly under-graduate degrees, they are not post-graduate masters courses, and they have funding in that way. The Institute view is that it is now necessary for there to be a seven year period of higher education to PhD level but the best, most flexible approach for the students is that the split should come at four years for under-graduates and then three years PhD training.

710. All physics students doing four year courses or only a proportion?

(*Mr Diamond*) We estimate 15 to 25 per cent.

711. When would the decision be made in their careers for this? The first year?

[Chairman *contd.*]

(*Mr Diamond*) They can all register for the four year course, and then after two years if they feel they do not want to continue with the four year under-graduate degree they can drop to the three year course. This gets past certain funding problems they would have.

Lord Phillips of Ellesmere

712. I detected a problem in all this. As I remember the argument, it was that people who aimed at a professional career in physics would need to be taken up to the higher levels of current thinking in physics, doing quantum chromo dynamics or something in the final year of their under-graduate course, but that physicists going out into the wider world would not need that level of expertise. I understood that argument and it was indeed why only no more than 25 per cent of physicists would actually take that fourth year. However, this has rather elided into the proposition that all physicists should have four years. That is one point which has been lost sight of slightly—I am not saying it has been by the Institute but generally it has elided into four years for everybody. Secondly, the people going out into the wider world are particularly those who need communication skills, awareness of industry and all the rest of it, and I do not know where that came into the four year course. That is where the M.Res is different.

(*Professor Sir Arnold Wolfendale*) Yes, but in the M.Phys, or whatever else you wish to call it, the fourth year of this course would, or should, contain quite a significant element of this particular activity.

713. But it is the people who are only taking three years who need that as well.

(*Professor Sir Arnold Wolfendale*) You can argue this sort of thing should be present at school as well, that there is a sort of wedge coming all the way up. I would agree the three year people need some of this too.

Chairman

714. The trouble about all these things is that you are forcing the decision further and further down, to the younger people who are immature and less able to make these decisions, and perhaps there is an argument for retaining a broad first degree of three years and then beginning to think about their future. Would the Institute of Physics be against that? Particularly in view of the fact that one hopes, at least I hope, there will be a broad pattern of studies for the school leaver?

(*Mr Diamond*) I think our worry, and my Lord you have brought this up in the additional questions you sent us, is that although that may give you an extra year to think if this qualification is not viewed positively either by particular research councils or by industry then you are doing your students a disservice. From our own evidence from our corporate affiliates and organising conferences for industry across the disciplines, not just in physics, we found no particular enthusiasm for the idea of an M.Res. Certainly from the universities themselves, from the practical point of view of putting on these courses, as we understood it, they felt they were going to be over-loaded having to think up projects which were not going to contribute to the research out-put of the departments, unlike the PhDs. Yes, it may be useful to have the year to think, but then if the qualification you acquire in that time is not going to be a benefit to your career, is that a good idea? The Institute was really quite "anti" this one year Master of Research. Can I add another thing as well? We did advocate that communications skills and transferable skills should be in the three year BSc degree, and in fact we recommended a cut in the content of the curriculum in order to make space for that. We feel it is important for all physicists to have the background in transferable skills, professional physicists both in university careers and in industry, and therefore both degrees should contain an element of it, not necessarily just in the fourth year but integrated into the whole under-graduate curriculum in all years.

(*Professor Sir Arnold Wolfendale*) I think, my Lord Chairman, one could make a case for rather less QCD, quantum chromo dynamics—the basis of all chemistry and physics—and rather more communication skills. It comes back to your remarks about this base.

715. It can be argued, of course, that if a subject is really advancing what you say about it gets less and less, not more and more, because incomplete theories give way to larger, more comprehensible and more comprehensive theories. There is a lot of stuff in the under-graduate curriculum which is really old hat.

(*Professor Sir Arnold Wolfendale*) Yes.

Chairman] I think that is the point to draw this to a conclusion. Thank you very much for coming.

TUESDAY 4 APRIL 1995

Present:

Craig of Radley, L.	Hilton of Eggardon, B.
Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Haskel, L.	Renwick, L.

Memorandum by Association of the British Pharmaceutical Industry

The Association notes that the enquiry will examine the current arrangements under which research scientists work, and will make particular reference to the perceived dependency on short-term contracts. We note that it will focus on the case for improving career security and that it will also cover what are perceived to be related issues: the position of women in science, and the Government's proposed Master of Research qualification. Not all of the issues raised by the committee will be of relevance to the pharmaceutical industry, and we have therefore restricted our comments accordingly.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

It is the Association's opinion that the present situation is inherently unstable: the present career structure evolved during a period of sustained growth in the academic sector and now has to accommodate minimal growth of the sector and major changes in funding, not to mention fundamental changes in the pattern of modern science. We perceive few advantages and many serious problems with the current career structures.

In general the career structure of British Universities with their too heavy emphasis on teaching and administration does not allow the development of high quality research in quantity and discriminates against women due to the lack of continuity in their careers. It is felt that the system does not favour the bright young scientists getting their ideas accepted for grant applications.

The current environment is one in which success (an academic career) for a postdoctoral scientist depends upon establishing their own laboratory/group staffed by research students and postdocs—who will in turn expect to be able to do the same. This brings two problems: exponential growth (which clearly cannot be sustained) and the fragmentation of research. A decreasing number of problems in modern biomedical science are susceptible to competitive attack by a single senior scientist leading a group of research students and postdocs—bigger teams are needed to cover the range of different disciplines and skills that are required. For a good post-doc to move away and set up their own research group in the same general area is antithetical to maintaining strength in a single site.

Obviously what happens is that only a small proportion of postdocs are successful in following this career track or scientific "ladder" and many move to industry, or out of research science into management positions, or into more lucrative/attractive professions early in their careers. These are not necessarily undesirable options, and it could be argued that this selection pressure is desirable. The damage is done because these alternatives are seen as the options followed by those who have failed, a perception derived, one might argue, from academic snobbery.

The loss of tenure, which previously had provided a measure of reassurance, has, it is believed made matters worse. Although tenure sometimes led to complacency, its loss has not led to a removal of poor performers and has, we consider, potentially discouraged otherwise motivated bright young talent from entering a career in academic science. It is important to allow long-term ideas to come to fruition and provide stability in departments and so development of track records. One possible solution would be an extension of the system currently in place in some universities where there is a probation period of two years, and then to have five or 10 year renewable contracts.

It has been suggested that the scientific community needs to reassess the best way of structuring research groups within academic laboratories. One view is that what is needed is a complete change and the encouragement of a new career option—the academic equivalent of the established industrial scientist. On this model there would be permanent posts for doctorally-qualified bench-working research staff working within a group. Permanent need not mean tenured, and the posts could involve some teaching duties. This change in structure needs to be accompanied by a marked reduction in the numbers of post-docs "working their way through the system". An inevitable consequence is that Departments would have a limited range of research projects—but each staffed by a sufficiently large group to make internationally competitive progress. A further consequence is that the senior person in each group becomes more of a research manager – but possibly needs to spend much less time writing applications for small grants to fund individuals. Managing a research group may also be seen as a less desirable option by scientists who enjoy research if job security does not demand setting up and getting the grants for a personal research group. One major benefit (and this is relevant to the Committee's question on short-term contracts) is that expertise builds up within the group and is not lost every time a post-doc leaves. It also encourages a rather longer-term view of research than is possible with three year contracts. The major change would be in freedom of choice for the individual senior research worker who would now have to work within the framework of a Departmental research plan and would not have autonomy. This of course challenges the long cherished concept of academic freedom and also risks the loss of innovative ideas that the support of individual scientists does offer.

A major complication of such a scheme would be in sustaining breadth in teaching—already a problem in many disciplines where the attractive science is moving away from the core disciplines of the vocational course. It may be that the solution has to involve greater mobility of students once they have obtained their basic grounding in the general area. A partial solution might be to allow some of the permanent posts to be 50 per cent research, 50 per cent teaching. It is possible that this proposal would stifle creativity, innovation, and exploration. Nevertheless it is considered there has to be a mechanism to allow for some innovative exploration and this could be through funding individuals not groups. A diversity of structures and mechanisms will be needed.

On the issue of financial reward, academic scientists are poorly paid and are not rewarded as highly as roughly equivalent professions requiring a similar level of training (eg compared with accountants, health sector professionals etc).

2. *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

We see very few advantages from the employee's viewpoint. The advantages of the short-term contracts lie largely with the employer, ie flexibility of the research team, possibilities for revitalisation of skills and know-how, provision of a mechanism for damage-limitation of inappropriate appointments. This may also encourage the wrong appointment.

There are many disadvantages for the employee. As in our response to Question 1, a major disadvantage is in the loss of key technologies from research groups as individuals leave: this is not really compensated by the opportunity to acquire new technology since the new incumbent is likely to be less experienced and will need to develop the technique. Once the new technique is developed, that person moves on, having snatched a few quick papers, if they are lucky, and the cycle repeats itself, ie there is no continuity in skills. This encourages the person to stick within a narrow field. In industry by contrast research projects are changed frequently thus challenging the staff.

A second disadvantage is the time wasted in learning (the first year in some cases) and the time spent job-hunting moving laboratories and writing grant applications (the last year). Since nobody will turn down their next grant or a good permanent job, once they have started job-hunting the final "year" may not last long, especially with good people. A three-year contract may produce as little as 12-18 months of good work. There is no long-term security in short-term contracts. Older temporary employees become too expensive compared with their younger, cheaper counterparts. Because of the cost pressures this discriminates against the progression of the career of more senior postdoctoral scientists and diminishes the skills of the team. The proliferation of one and two year grants discourage people from taking up careers in science. Academic scientists are led to consider that there is not a career structure in science, and thus they leave to find employment elsewhere, eg the City.

Although not directly related to short-term contract employment in academia, a possible problem with short-term contracts placed by industry (as distinct from collaborative research ventures) is that the universities become "contract houses" for industry. Contract research, unlike collaborative work, may not be academically challenging and may, in some cases be only done for funds. It is sad if very promising scientists are forced to do this kind of work because other funding is not available. The Research Councils should be encouraged to provide three or five years renewable/rolling grants which would allow the principal investigator to do a solid piece of research and publish results.

3. *How do you expect the situation to change in the next decade? (Please bear in mind, among other factors, the current age structure in full-time university posts and expected changes in university income levels and sources?*

There may be some marginal improvement in the next 10 years because of early retirement schemes for the "baby boomers". There does not appear to the Association to be any radical measures being proposed at present that are likely to be successful in reversing the current low esteem of academic science.

4. What should be done to improve the mobility of scientists between academia and industry?

Movement into industry operates well at the undergraduate level (eg vacation students, summer scholars and sandwich students), although companies may not be able to provide as many places as academia would like. LINK awards and CASE schemes also provide very useful interactions. Many companies have established programmes but are seeking to enhance the interchange at the post-doctoral level.

We suggest that there is no need to try to improve movement from academia to industry—the present policies are working well and will continue provided the economy is healthy and industry is thriving. Indeed, as academic careers become less and less attractive as morale declines, grant-writing becomes less likely to succeed and teaching loads increase, we foresee an anticipated increase in academic scientists wanting to leave, and to join industry. Such long-term career moves from academia to industry tend to be in mid-career when technical expertise in a specific discipline is required by industry.

There does appear to be some problems concerning UK academic scentists waiting to take sabbaticals in industry here. Apart from the observation that many appear to want to head off to warmer climates, there are a number of other factors that need to be addressed. It may be that in times of recession scientists are uneasy about leaving their current position, even for a short period. Any such move should therefore provide clear security of return to the former organisation. Despite the major advances that have been made, particularly since the publication of the White Paper on S,E,T ("Realising our Potential") a means must be found to overcome the element of "snobbery" that to an extent, exists in some universities, and the lack of acknowledgement that industry is doing cutting edge science. The myth that science in industry is somehow second-rate must be dispelled as it continues to discourage those who believe it from cooperating with industry. A shortage of funds, together with more realistic views on overheads and the management of intellectual property, has made industrial cooperation more interesting, at least for enlightened departments.

Incentives, including, but not only financial ones, should be provided. Specific research funds could be made available by Research Councils and companies when research programmes demand such an investment to support 1–2 year research "sabbaticals". The ABPI is encouraged by initiatives in this area under consideration by, for example, the MRC.

For a number of logistical reasons, the current arrangements for the Teaching Company Scheme are not appropriate for larger companies as found in the pharmaceutical industry. They should be reviewed if the involvement of the pharmaceutical industry is to be encouraged. They would certainly be of value for biotechnology companies and other SMEs in the UK.

Long term moves from the industry back to universities tend to be chairs when industrial scientists are "winding down" but still have considerable experience to offer academia. However for most academics who have been in industry for more than a few years, moving back to academia is not an easy option and would be extremely difficult, and almost impossible to a junior teaching post. Not only would it be financially unattractive, but it would probably also mean moving to a much less well-equipped research unit with very much tigher constraints on consumable expenditure—in other words it would be much harder to do good science. Returning to academia would generally mean joining a research group for a less senior scientist. Setting up a research group from a standing start would be very hard without guaranteed research funding for the first few years and sufficient time to do the necessary recruiting. To encourage movement from industry to academia will require a major financial investment into the academic sector. The Association is aware that in the United States, mobility of scientists within industry, within academia, and between the two is much greater. The Sub-Committee may wish to consider why there is such a difference? The Committee may wish to consider the implications of the anticipated support, within the European Framework Programme for R&D, of the secondment of many scientists over the next four years via a variety of funding mechanisms.

In the past the "generous" EU funding of seconders has caused problems in the UK—this being a reflection on the poor remuneration of our academic research scientists.

5. How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?

Many of the key issues concerned with this important topic were, we consider, identified in the study and subsequent report by the Office of Science and Technology "The Rising Tide—a report on women in science, engineering and technology". The present enquiry by the Select Committee will hopefully provide a timely review as to the progress of the implementation of the report's recommendations.

It is hoped that the number of women studying and pursuing careers in Science, Engineering and Technology will increase in the next decade. The introduction of the Science National Curriculum means that all students have to study science for a minimum of 10 per cent curriculum time until they reach the age of 16. This means that potentially there will be more female students able to continue studying sciences post-16. Prior to the National Curriculum the majority of female students opted to take only Biology post-14, thus restricting options for future study.

The figures for students studying Biology, Chemistry, Physics and Maths at degree level has shown a slight increase over the last few years. Monitoring of the number of female students going on to study science post-16 since the introduction of the National Curriculum will be important.

The Association does not think that scientific careers are necessarily unattractive to women, there are already more women graduates than men in pharmacy. For many women careers in research are difficult to manage, with the issues of childcare and partners' careers main factors in the planning. Women's position in science has improved over the past years and the UK is ahead of some other countries. There will be major changes taking place in the next 10 years but these will be slower than desired, as they will require an alteration in deep-rooted social attitudes, rather than simple "acts of will" by individuals.

Society will continue to face the problems faced by the perceived conflict of marriage/motherhood and careers for women. Some of the actions to overcome this might include:

- Encouragement of part-time/job sharing schemes and flexible working practices.
- More female science teachers/better quality science teaching at school.
- Better quality careers advice at schools and university.
- Higher visibility of qualified female scientists to provide role models for young women. The promotion of positive images of women in science WISE (Women in Science and Engineering) has been active in this field and should be supported.
- The provision of educational support material. Both sexes should be promoted in such educational material. The Association has an active schools liaison programme and promotes positive images of women scientists. For example, in our graduate careers brochure nine of the 15 career profiles depict women.
- Easier access to childcare facilities and tax allowances on money spent on childcare.

  (It is probably more important to try and keep women in the system rather than encourage three to five year career breaks which do not work well in science. Childcare facilities are often expensive, and not always convenient. Low academic salaries prevent women scientists from paying for childcare and hence they drop out. Both industry and academia should be encouraged to provide childcare facilities at the place of work, although it is recognised that the cost of such facililties are very expensive, making such provision difficult. Joint arrangements with local authorities may be a way forward.)
- There should be more support (grants etc) available for women returners to academic science (eg the Daphne Jackson fellowships). There needs to be improved conditions for extended leave for those who choose to take a career break. "Keeping in touch" policies need to be established.
- Employers (industry and academia) need to be educated on the positive benefits of women in key managerial positions, in general.
- The implementation and enforcement of equal opportunities policies.

It is considered within the pharmaceutical industry that more women will reach more senior positions in science and engineering in the next decade, since there are more young women entering these areas. It should be asked whether we should give careful consideration to whether affirmative action would be an advantage. Should companies and academia set a target for proportional representation at every level and in every discipline? Many would consider that this is an incorrect tenet, and only the best people be selected for the job. This could be 90 per cent women in some cases. Nevertheless some way must be found to correct the historical imbalance.

One thing that may speed the change is that science is not seen as an attractive career and thus shortage of talent may force society (academia and industry) to adjust working practices as outlined above to accommodate women who want to follow a career in science without sacrificing all family opportunities. This may make some difference—but probably not a major change towards equal representation. Perversely, any improvement in science as a career option may result in keeping the number of women low.

What is necessary is to change the perception that science and particularly technology are mostly a male preserve; this change has to take place fairly widely otherwise unconscious bias even in interactions with very small children will continue to reinforce the role-assignment. That the perception is based upon false premise and is incorrect does not weaken its effect. As more women work in S&T the fallacy will become harder to sustain—but the change will be slow to filter through to those who spend time with pre-school children.

6. *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of the scheme*

The Association welcomes the fact that the Office of Science and Technology is carrying out a pilot study of its MRes proposal. In commenting, in 1994, on the OST consultation paper on the proposed new structure for postgraduate research training, the Association expressed concern at the time over proposals to make such courses mandatory. In our submission (Attachment 1) we acknowledged that there was an issue of poor quantity with some PhDs, but that these were associated with fundamental problems with the whole educational system and would not be resolved simply by a qualifying partly taught Master's year. There was however some support expressed by the pharmaceutical industry for the introduction of any initiative that would make the PhD degree a deeper educational and learning experience.

This support was based on the recognition that many universities were failing to provide adequate practical laboratory experience for graduate students.

The Association considers that at present the MRes may not offer much advantage to graduates seeking employment in the pharmaceutical industry. However, until such graduates are on the market place it will be difficult to comment on whether they will be sought by the industry. In view of the lack of practical experience of many graduates it is possible that companies will recruit those with MRes qualifications in preference to those with first degrees. We do however continue to have concerns over the failed PhD image that may be associated with the MRes, and doubt that the possession of one would justify a higher starting salary, compared to a graduate from an appropriate course. The pharmaceutical industry has, in general, expressed the view that it wants PhDs or graduates who have a relevant broad-based scientific background who can then be trained on the job in certain specific activities in the way companies consider to be the most relevant to their requirements. The industry does not however expect to have to train these people in the basic, fundamental skills of a laboratory scientist that they should have obtained during their university courses.

The Association accepts that although the MRes may not be relevant to the specific nature and needs of the pharmaceutical industry, it may be applicable to other sectors eg engineering, field geology etc. We look forward to the outcome of the OST pilot study, testing as it will the concept of a longer PhD course and a more structured first year. We would hope that if the pilot study proves unsuccessful then the "guinea pigs" should not be disadvantaged in any way through their inability to obtain further funding. It has been noted by the ABPI that if, as has been stated by the OST, the average length of the PhD will not exceed three years, then unless funding is increased there will inevitably be an associated reduction in the number of PhDs funded.

The Association believes that there should be more effort made to improve the current undergraduate science course by better advice on module combination, more emphasis on practical work, and where appropriate better use of industry contacts for sandwich employment. There is increasing support from the pharmaceutical industry for four-year degree courses. Such courses are already being introduced for subjects such as chemistry and physics, and moves towards four-year first degree courses in biomedical subjects are a possibility. This development has led some in the industry to suggest that undergraduate degree courses could be split into two-year modules with mobility after the first. It has been argued that only those students completely committed to a career in science would choose a two-year science specialisation option. The Sub-Committee may wish to seek further views on this suggestion.

APPENDIX 1

A New Structure for Postgraduate Research Training Supported by the Research Councils

Comments from the Association of the British Pharmaceutical Industry

1. INTRODUCTION

The Association of the British Pharmaceutical Industry represents the majority of the pharmaceutical companies operating in the UK supplying the NHS. The industry is a major employer of postgraduate scientists and has, therefore, a vested interest in the overall standard of PhDs in relevant disciplines. Unlike many other industry sectors, the range of such disciplines in the pharmaceutical industry is broad, with particular focus on the biological and chemical sciences. The UK pharmaceutical industry has been extraordinarily successful in recent years and remains one of the few manufacturing based wealth creators of the country. As we have emphasised on numerous previous occasions much of the success of the industry has been based on the quality of the educational system in the UK. The industry, however, has been concerned for some time over the apparent decline in quality, not only of the available science PhDs, but of the graduate students going on to do research awards. We therefore welcome the healthy debate on postgraduate research training that has been initiated, by the recommendations in the White Paper on Science, Engineering and Technology, "Realising our Potential" and by the present consultation document.

We agree that there should be consideration as to what should be the exact nature of the PhD, and what numbers are required to meet the various socioeconomic needs. Arising out of the debate we would hope to see a better structured system of PhD training, including necessary improvements to the supervision of such students, and a greater encouragement to enter into higher education generally. The Association and its member companies are not convinced, however, that the serious issues that have been identified with current standards will be solved with the proposal that there should be a formal Master's year leading (in most cases) to a four year PhD study. It is accepted that there is a need for diversity in the provision of postgraduate training, and the proposals in the consultation paper could have some applicability in various industrial sectors and scientific disciplines. We do not see it as the only way forward. If the Master's year is to be introduced, we strongly recommend that the Office of Science and Technology gives serious consideration to resolving the numerous practical difficulties that, we are aware, have been identified by the universities, professional bodies, other industry associations, as well as the pharmaceutical industry.

2. SCOPE OF THE CONSULTATION EXERCISE

The success of the pharmaceutical industry sector is well acknowledged and our innovativeness, efficiency, productive capacity and close liaison with the science base epitomises what the White Paper is seeking to achieve for all other industries. However, the industry is faced with numerous new challenges including increased international competition, pressure on prices, recessionary influences, increased regulatory pressures plus burgeoning scientific progress. There is a danger that the industry in the UK may lose its innovative edge and that growth may not be sustained. If the industry is to continue to invest in the UK, it is essential that the quality of the science base is maintained at the current high level. The current review of the postgraduate training system cannot avoid the issue of needed improvements to scientific education in general.

We consider that despite evident scientific progress, there are beginning to be serious concerns expressed regarding the quality of the science PhDs now available, and that this has its own origins in the education climate early in school education. Alterations at the PhD level will, in the long term, be of little value unless corrective action is taken at lower educational levels. It is apparent that the UK is falling behind other countries in the percentage of the population participating in higher education. Efforts to tackle this as a priority are needed, and the recent activities of the Minister of Public Service and Science to promote science are to be welcomed. There does remain, however, a number of problems relating to the teaching of science in the National Curriculum, at 16–19 years old and at the undergraduate level. It is acknowledged that the present OST consultation exercise is restricted to Research Council supported postgraduate research training, but we must express our concern that once again, without input from the Department for Education, an opportunity has been lost to review the 16–24 education system (and earlier) as a whole.

3. INDUSTRY OBSERVATIONS ON CURRENT PHD STANDARDS

The stated reasons for the changes proposed in the consultation paper are the encouragement of high quality research training and a broadening of transferable skills. The government appears to be seeking to introduce the changes because the quality of many PhD students (and therefore PhD degrees) is too low. Quality can be assessed as a level of intellectual development, of mental agility and flexibility, of the capacity for strategic thought and of flair and imagination. Alternatively it may be viewed as a result of greater book-learning, training in techniques and exposure to business principles. The latter view appeared to be the guiding principle in the recommendations in the White Paper for the pre PhD Master's year.

There is a view in the pharmaceutical industry that quality, as relevant to a research based industry, can be developed not by extra courses and years of study, but by experience in appropriate environments. A PhD gained by study in a large group with several postdoctoral researchers working in a well supported laboratory, in a competitive area at the forefront of science is the ideal situation. This will have much more quality than one achieved by a solitary postgraduate, with poor supervision and facilities, on a topic of no significance.

The facilities in many universities, as well as the financial reward, for researchers and lecturers are, we believe, very poor. The lack of facilities can be particularly acute for PhD students and the Association is aware of CASE students who would not otherwise have been able to do the experiments necessary to attain the minimum PhD standard, and obtain their degree, having to be "rescued" by companies;

It is clear from cooperative awards such as CASE, and from involvement with other research councils that industrial supervisors have also had to rescue students because of poor standards of supervision in the academic institute. It is possible that poor academic supervision could be related to poor morale but is more likely to be the lack of a coordinated system of control.

The industry is aware that a few PhD students do leave within one year of starting their courses. Little thought appears to have been given until now as to why this is and as to why some of the best undergraduates fail to pursue a PhD course. This could be due in part to the current job climate with some leaving to take up job offers; in other cases the student is clearly not suitable. Ideally such candidates should be weeded out prior to the commencement of the course. Many students are unprepared to accept a further three years poorly paid training. We would suggest that to impose a fourth year of poorly rewarded endeavour as suggested by the MRes proposals, would discourage many more, particularly if they had already studied for four years to obtain their first degree.

It is felt that universities have lost, in part, their promotion of a curiosity-driven approach to undertaking a PhD. As mentioned above, there is a need to re-emphasise the curiosity-driven innovative approach to the PhD where the ability to think strategically and creatively is developed. Care is needed not to confuse quantity and output with developing the more demanding creative and innovative abilities which are at the core of the PhD process.

There is also much concern within the pharmaceutical industry regarding the experimental ability of many new graduate scientists. This is due to a number of factors; science is progressing at an expanding rate resulting in additional course material; emphasis is being placed on a range of personal transferable skills such as word processing literacy while the weight of increasing HSE legislation is leading to supervisory and cost issues with laboratory based experimental work. Some estimates of the time spent on practical work indicate this is now about one third of what it was 20 years ago. Employers are increasingly being expected to make good experimental deficiencies in graduate scientists.

4. *The Research Master's Proposals*

Although the Association does not consider that the proposals in the consultation document as the best way forward, we do support the Office of Science and Technology in its efforts to improve postgraduate training in the UK. The success of the pharmaceutical industry is, as stated earlier, dependent upon the provision, by universities, of high quality research training. We also accept that there is a need for some broadening of transferable skills, although emphasis needs to remain on the development of research skills. The Association considers that the PhD provides an essential component of scientific training enabling the development of a competent bench scientist who has the ability to think.

The apparent need for the proposed Research Master's qualification is to act both as an initial assessment and screening mechanism for those who want to enter into a PhD, and also to form a new stand-alone research-based qualification, distinct from existing taught specialist or conversion MSc courses. We consider that it will be difficult for both aims to be achieved.

We share the view that the proposed Master's year could be one of many possible routes into a longer research-based period of training. There will be others, including sandwich year and four year undergraduate courses. In some industry sectors the MRes qualification may be seen as a valuable qualification in its own right, and students who have chosen not to proceed to a PhD will find employment in such sectors. It is not felt that this will be the case in the pharmaceutical industry. However, in view of the current shortcomings in the practical element of undergraduate science courses, it is possible that such Master's graduates will be employed, but this will be at the expense of the employment of first degree graduates, without any salary premium for the extra year of training.

In addition, the Association cannot see how the stigma of the MRes being a failed PhD can be avoided if it is to be promoted as a necessary prequalification to a PhD.

We agree that the first year of a PhD should provide a formal training in methods of research, and an initial exposure to the practices of original research. For those who wish to change career it should help them to leave, but this function should not become the dominant element. It is stated (Para 13.3) that the new structure will also provide a "useful alternative to longer undergraduate courses". The Association would prefer to see improvements at the undergraduate level so that the quality of all science based graduates is improved. The introduction of the Master's year will not provide sufficient numbers of sufficiently qualified graduates.

5. MASTER'S/PHD BALANCE

As no new funds have been provided to pay for the extra Master's year the consequence is that funding will be at the expense of existing postgraduate training. It is most unlikely that industry would wish to sponsor such courses. It has been estimated that the supply of qualified PhDs will fall by approximately 20-25 per cent. The Association would view any reduction in the number of quality PhD students as a retrograde step and not in keeping with the main aims of the White Paper. It is not clear from the consultation paper whether everyone wishing to, and judged capable of, progressing from the Master's year to the PhD be guaranteed funding for the latter. It is also not known what effect this will have on the number who can then start on the Masters and on the number who can be accepted directly into the PhD.

It is our interpretation that although the extra year *may* be relatively cheaper than a year of study for a PhD, there is the expectation that many students will take the Master's course and not progress to the PhD. What may be an appropriate Master's:PhD ratio for one scientific sector eg engineering, will not be applicable to another eg biomedical sciences.

The OST will be aware of the findings of the recent SERC/Institute of Manpower Studies report (IMS) which has demonstrated that there is a flat or increasing demand for PhDs by industry over the period up to the year 2000. We agree that in view of the current recession such predictions should be treated with caution, but there is no indication from the pharmaceutical industry, or from academia, that demand will decrease significantly. Any moves to reduce the numbers of PhDs should be discouraged.

6. SELECTION FOR AND CONTENT OF THE PHD STAGE

The Association accepts that the assessment of students during an extended period of research and practical training could help to provide a foundation for their selection for further university research training. The consultation paper states that judgement will have to be made using references written part way through the year. This will introduce a number of logistical problems. The student would need to know as soon as possible whether he/she is to be allowed to continue to a PhD. Too short an assessment period would not give a reliable indication of suitability for further training and research. It is assumed that the research element ie the performance of (or assistance with) a practical project will be placd first in the course. If so, a way would need to be found to ensure that students also get the benefits of related lectures and training in techniques etc. We would also assume that ancillary training should be at the end of the year, since this is irrelevant to assessment. It is not clear on what basis the student will be assessed of deserving a Master's qualification, but not capable of going on to do further research.

We do consider, however, that with suitable improvements to the current system, present arrangements for the supervision of PhDs could have addressed the assessment of students. We feel that there should have been a far stricter control over the transfer of student's from MPhil to PhD, with the need for a full report on and review of the student's capabilities at the end of the first year. Following this examination a PhD could be awarded after a further two years in research. Many universities including London, Manchester and Nottingham currently run such an MPhil year as the first of a three-year PhD. This year includes teaching in relevant research skills (communications, use of library and other information systems, statistics etc) and does enable students to leave after the first year with a qualification if appropriate. This could have been usefully extended to other universities since it achieves many of the stated objectives of the MRes, including taught elements on relevant subjects, but within three years.

The Association is doubtful whether the end-product, of the Master's year, plus PhD, will *a priori* be better than that of the present PhD system. A greater emphasis on training in "good" environments, plus attendance during the final year at one week courses (such as CRAC, previously run by SERC and sponsored by industry) may be cheaper and more appropriate for the demands both in terms of quality and quantity.

The paper suggests (para 21) that students could undertake a full-time Master's research year but follow up their studies for a PhD while in employment, or to undertake a research Master's qualification part-time while in employment. We do not consider that either approach would be supported much within the pharmaceutical industry. It is possible that companies would recruit those who have already obtained the research Master's (but this would most certainly be at the expense of graduate employment) and enable them to study for a PhD within the company. Many companies are finding, however, that "in-house" PhDs do not provide the appropriate educational exposure and stimulation. It is also unlikely that the industry would want to support their staff to do a part-time Master's year. Most of the content of the course cold be provided through normal working environment.

We do agree that appropriate full-time research students should be encouraged to work on industrially relevant research projects. CASE and collaborative awards already do cover this.

7. Content of the Master's year

If the proposals are implemented the Association believes that the pharmaceutical industry would support the fact that the course should include a significant research component, and a grounding in research. The lack of equipment in universities to teach Master's students the range techniques anticipated will however cause problems. The end of dual funding will mean that the HEFCE will have to provide this. The pharmaceutical industry is reliant on the availability of high quality, high tech equipment, from computer graphics and sensing equipment, through to HPLCs, MS, NMR etc. It is not expected that academia will have access to the same level of equipment, but there will be a minimum standard below which they will not be able to function effectively.

For the purposes of the Master's year it is apparent that many universities will have to organise the courses in consortia in order to achieve greater efficiency of effort and resource. This will be possible in London and larger urban areas but will leave places such as Wales (eg Aberystwyth), Scotland (Aberdeen), Exeter and many others, particularly smaller HEIs, in some difficulty.

There is a need for a taught element within the research course but modules designed to broaden the students' experience should not constitute a large part of any such Master's year. An emphasis on commercial understanding and management skill would not be major elements for a course aimed at those entering into pharmaceutical orientated R&D. Interpersonal skills training and business awareness are things that can be well instilled during subsequent employment, if relevant to the person and the need of the employer. Although there is support for a taught element, there should not be too great a shift to formalised training, at the expense of an assessment of the students creativity.

8. Proposed Models for the Master's year

We note that the consultation document has identified two models for the possible introduction of the Master's year. The Association shares the view that these are only two of a number of possible solutions and that it will be up to universities to identify the best ways forward to implement the proposals. We have no preference for either model but do consider that considerably more thought needs to be given to the practicalities of the two proposals; how the funding of the student is affected, and how PhD regulations on the submission of these would affect the application of the results obtained from the research project.

9. EXEMPTIONS FROM THE RESEARCH MASTER'S REQUIREMENT

The teaching of physics is already being organised nationally with four year degrees, essentially to make up for the deficiencies in the teaching in schools. In chemistry a number of universities already have four year degrees with the final year involving a project (eg Oxford). Many universities have four year sandwich courses. We would assume that (para 28 iii) all sandwich students and those having done four year undergraduate courses, including Pharmacy, will be exempt from having to do a full Master's year. The Association notes that it is recognised that it may not be appropriate for the successful completion of Research Master's year being the first step for *all* students seeking Research Council support. We would hope therefore to see a number of possible options and not a fixed position with a number of possible exemptions.

10. PROCEDURES FOR RECOGNITION BY RESEARCH COUNCILS

We agree that, if the Master's proposals are to be implemented a priority for the Research Councils will be to develop suitable procedures and criteria to be met by courses taking into account the needs of users. We would expect that such procedures will be based on further consultation with industry, either as a separate exercise or through industry sector representation on the Councils. We endorse proposals that have been made that there is a need for the establishment of pilot schemes to help assess the procedures and criteria, and to see whether the new system is achieving its objectives (para 32).

11. RESEARCH ASSISTANTS AND STUDENTS NOT SUPPORTED BY THE RESEARCH COUNCILS

The Association considers that Research Assistants have proliferated because they are better paid than PhD students. If the stipends for PhD students were improved then there may be less need for Research Assistants.

There are a number of implications for the pharmaceutical industry of the proposals for students not supported by the Research Councils. Many biomedical and biological orientated PhDs employed by the industry have previously been supported by three year grants to academics. The former are often of very high quality (eg Wellcome Trust students) and there is no evidence that PhDs obtained by Research Assistants are lower in quality than those obtained by more usual means. Addressing this has to be a matter of discussion between the charities and the Office of Science and Technology. It should also be emphasised that the pharmaceutical industry supports a large number of fully-funded PhD students in universities. It is unlikely that the industry would want to have to give four years of financial support to such students.

The wider implications of the proposals are obvious. The situation will arise where the majority of Research Council funded students may have to follow the four year MRes/PhD approach, while students funded by other bodies able to complete their studies in three years. This disparity will cause problems and the concept of a "two-tier" PhD must be avoided. Either the Master's year is useful, or it is not. If employers do consider that it is useful, then the recruitment of those PhDs who have not done the Master's will be reduced. The opposite, of course, is also true.

12. SUMMARY

The Association feels that the poor quality of some PhDs is due to fundamental problems with the whole educational system, that will not be resolved by a qualifying partly taught Master's year for certain students. There is a strong view within the industry that any additional resource would be better used elsewhere in the education system. We need to continue to find ways of creating an environment that will encourage the brightest and best into science in the first place. We need fundamental not mechanical solutions to problems of science training.

If the UK pharmaceutical industry is to remain successful in the longer term as a net contributor to UK PLC there is a need to improve the quality of PhDs in relevant scientific disciplines. This will require a concerted action not only by the HEIs but by government and others concerned with our current education arrangements. The pharmaceutical industry will play its part but, as we have outlined, in the coming years it will face major challenges in the areas indicated. Inevitably, this will cause the industry to focus on its business activities and increasing reliance will be placed on the HEIs to educate and train PhDs to improved standards. If this doesn't happen there will be a further decline in the overall UK standing. For the reasons stated, the proposals in the consultation paper for changes to postgraduate training are not seen as a solution to this growing problem.

Examination of witnesses

Dr Paul England, Director and Vice-President Screening Sciences, SmithKline Beecham Pharmaceuticals, **Dr Michael Elves**, Director of Scientific Affairs, Glaxo Holdings plc, **Dr Mike Brady**, Manager, Research Administration, Zeneca Pharmaceuticals, **Dr Jeff Kipling**, Associate Director, Department of Medicine, Science and Technology, Association of the British Pharmaceutical Industry, called in and examined.

Chairman

716. Thank you very much for coming. We have looked at your evidence and we have given you a list of possible questions. I think we shall want to cover those but there will be other questions as well I am quite sure. On these occasions it is usual, and I think desirable, to ask you whether you or any of your colleagues want to make any general statements at the beginning, to highlight or to draw to our attention points which have not appeared in your memorandum.

(*Dr Elves*) Thank you, My Lord Chairman. Can I begin by introducing my colleagues from the ABPI who are with me this morning: Dr Jeffrey Kipling who is the Associate Director, Department of Medicine, Science and Technology of the Association itself; Dr Paul England, who is Director and Vice-President Screening Scientists of SmithKline Beecham; and Dr Mike Brady, who is Manager, Research Administration for Zeneca Pharmaceuticals. I am from Glaxo, soon to be Glaxo Wellcome. I am Director of Scientific Affairs for that company. We are very pleased to be able to have this opportunity of meeting with the Committee, my Lords, because the industry, being an intensively science-based industry, has got an interest in ensuring the health of our academic science base for two very good reasons. First, we look to that science base to provide us with a skilled science and technology workforce for our research laboratories, our development laboratories and also quite a large amount of our production and also marketing processes. Secondly, and becoming increasingly important to us, are the external collaborations in which our research colleagues are engaging with academics in British universities. We regard these collaborations of fundamental importance to us because it is our academic colleagues who are in a position to explore some of the underpinning basic science issues upon which we are in the future going to depend for drug discovery. We are very concerned that we have a healthy academic science base with which to work, and we are concerned to ensure that the career of the academic scientist is one that will support his position in that science base, will give him the training and the rewards that he (or she) deserves and will put him in a good position to meet with us as collaborators and colleagues.

717. Do any of your colleagues want to comment?

(*Dr Kipling*) Just to endorse what Dr Elves has said.

718. Just looking at your memorandum I got the impression that you were rather critical of the organisation of scientific research in universities. You said in some ways the organisation was not such as to attack major problems and groups—I think this was the implication I carried with you—and was not managed as well as in industry and by implication they were not managing their contract staff as in industry. Have I got the right impression there?

(*Dr England*) I think that our concerns were reflected reasonably accurately in the memorandum. We are, I believe, concerned that science is becoming much more multi-disciplinary. It is becoming an area where you need larger resources, where team work is going to be essential and that in a number of academic institutions there is still very much a departmental structure—perhaps this departmental structure is not the problem, it is much more individuals who feel they want to go their own way in specific individual areas. This means there is not the critical mass that is necessary. I personally strongly believe in the concept of centres of excellence and I believe in a lot of cases these have not been formed. I know inter-disciplinary research centres are an attempt to bring these together, but I believe in some cases these are cosmetic and a number of people put their names to grant applications which fund large equipment but there is not really the mass we see in industry. I think there is a role for more active management in some of these areas. That does not mean you do not want the individual scientists to be producing ideas in industry. We manage the science but also expect the investigator initiated research to come up. We need to balance that. It is more the bringing together of people into critical mass groups.

719. You would not have described Newton as a non-critical mass, would you?

(*Dr England*) No, I would not and I think there are always going to be a lot of examples like that. It is a problem even within a company, I should say, that even where we have got a management structure, of how you recognise the individual projects you can take forward with just one or two people to a certain critical point and then take advantages of it on a larger scale. I actually believe there is a balance to be struck and I do believe in certain cases you do need a certain mass of people to get this.

720. Whilst it is obviously necessary to have what you say in industry because you have targets to meet; possibly the situation should not be so directly, as it were, planned from above in universities but should leave some room for individual initiative. Is that what you are saying?

(*Dr England*) I think so. If I look at some of the American situations where there are very large units, I believe that quite a lot of the really major discoveries have come from quite large groups of people who are able to put a lot of power relatively quickly into the work. It is not so much getting the initial idea, it is taking the idea forward that we sometimes miss out on. I am not sure everybody will agree with that.

Lord Phillips of Ellesmere

721. I wonder then are you arguing in a way that the balance has changed too far from the situation, say, in the 1930s where, for example, if you went to do Cambridge physics you could choose any subject you liked so long as it was atomic physics that you wanted to do in Rutherford's group or if you went to do Oxford chemistry you were expected to join Robinson in organic chemistry where it was his programme of which you formed a part and so on to a situation that I think developed in the 1960s which may even have reflected the saying "Let a thousand flowers bloom" where each individual scientist had to have his own programme and pursue it himself. I happen to think that process went too far. You are agreeing?

(*Dr England*) From my experience—I was an academic lecturer from 1973 to the mid 1980s—I was allowed to take my own ideas forward in my own way. It worked, I believe, because the department had a number of core technologies where the different individuals, although ploughing their own furrows, had the opportunity of sharing technology and sharing ideas. Thus we had groups of four or five faculty members with their associated research teams, all of whom shared common ideas and thoughts, but each of us had our own projects. I am not suggesting that is the perfect model, but it is a model where I believe we were able to allow people a certain amount of individuality, but still bring together groups in inter-changes of ideas and new technologies. These could be investigated by the whole group in the same way, I would like to think, that research departments are run in industry.

722. Could we explore a little how research is organised in your industry which you are saying in many ways is quite similar to research in academia. Do you, for example, recruit people on short-term contracts some of whom move on to somewhat more secure positions? How do you do it?

(*Dr Elves*) It will vary in small detail from company to company, my Lord. I think the par for the course for the industry is that most, if not all, of our technology staff are employed on a "permanent basis" with rolling contracts.

723. That was a nice move from "permanent basis" to "rolling contracts"?

(*Dr Elves*) Like all of us, from top to bottom, they are on a contract that can be terminated by the company after a period of notice—six months to a year perhaps. Very few, if any, are employed on a three-year fixed term arrangement as you might expect to be employed on as a post-doctoral scientist working on fellowship in a university department. There are a small number of research fellowships which are held in companies on that basis. They are done very deliberately to provide part of the bridging into the academic world. There are, however, some disadvantages to that scheme. One is that once one takes a young scientist off his academic ladder at post-doctoral level into an industrial environment it is often very difficult for him to get back onto his academic ladder and continue to rise up it. The Industrial Fellowship Scheme that some of us are pioneering seeks to overcome that problem by leaving these fellows with a university department as well as with the company.

724. I see.

(*Dr Elves*) But if I can just turn back and address the Newton issue, my Lord Chairman. Newton might have discovered his principles single-handedly but to put them into practice today, in particle physics, he would need a large team. I think in our business this is more than usually true. Our business in the future has got to move towards the discovery of curative medicines because most of our medicines in the national formularies are not curative; they ameliorate or they are palliative. The community wants curative medicines that are going to deal with important diseases that affect large numbers of people—like rheumatoid arthritis—like schizophrenia—like Alzheimer's Disease. Biotechnology and the explosion of biological knowledge is actually putting us in a position where we can start to look to achieve this as a real goal. But we can only do that if we understand the disease process very thoroughly and identify the targets from that knowledge. It is that process of understanding the disease targets very thoroughly that is going to require multi-disciplinary research in the universities, as well as in companies. It is impossible to biopsy the brain. All the insights we have in most degenerative disorders of the brain come from pathologists' post mortem, by which time the battle is not only over, but was over a long time back and the players long since buried. We can get no real insight into the causes, for instance, of Alzheimer's Disease by that process. Therefore it is going to be vitally important that we can bring together physicists, with the imaging technologies, and the pharmacologists and bio-chemists who can relate back into those imaging technologies in order to get dynamic pictures of the processes in the brain in life and in pathological and normal states. Only in that way can we get away from guessing what our targets are, to becoming certain. With the increasing cost of drug development guessing is an expensive game and we cannot afford to go too far down the road with the wrong guess. This is why we regard the academic collaborations we all have as of vital importance, and why we would like to see a much more inter-disciplinary collaborative culture being developed in university departments, and between university departments, and between universities.

Chairman

725. I accept that completely but I was looking at a university calendar only yesterday and I was noticing what a change there was from five years ago, and you may think it is cosmetic, in the large number of centres which have been developed between departments. I am thinking of chemistry, micro-biology, bio-chemistry and crystallography which are combined. This is something I presume you would endorse provided you thought it was real rather than cosmetic?

(*Dr Elves*) A lot of these are far from cosmetic and some of them are very real indeed and those we welcome.

(*Dr Brady*) I think it is worth adding, my Lord, that this particular point has been picked up and discussed in the Technology Foresight Health and Life Sciences report and has been specifically referred to there and has been rather nicely put.

Lord Haskel

726. I was going to make that very point. It seems to me that what you are saying to us is that research is less about making discoveries but more setting up teams to solve problems.

(*Dr Elves*) And making discoveries, my Lord, in the process.

Chairman

727. You also make some criticisms, which I think are quite important because they relate to the future of research, about the practical training of graduates and undergraduates at varying stages of their existence. Would you like to elaborate on that? There are people round the table who have had some responsibility for this training and would be interested to know what has happened.

(*Dr England*) Perhaps, my Lord, I will start and I am sure my colleagues will want to add some further comments. The concern that we have raised a number of times is in the decrease in the amount of hands-on practical training that is now part of the standard undergraduate degree. This is a reduction in numbers of hours; it is a reduction in the quality of equipment used. I think it is seen probably most starkly in terms of animal experimentation and *in vivo* animal experimentation for physiologists and pharmacologists. That is only part of the problem and has, of course, its own issues. At the general level the amount of practical work is going down. The amount of money which is allocated to projects is minimal. I happen to know one university where I give a few lectures where it is £70 a year for a 30-day project. You cannot do anything significant on that amount of money. This means the projects are poorer quality. That means the people we employ as graduates do not have the ability to walk into a laboratory even with basic training on safety, and do experiments without extensive additional training. We see the difference where we have sandwich students. A sandwich student will come to us at the end of the second year. Those people probably have the same skills as people who come to us at the end of the third year with a degree. That third year has not added a lot more skill. That one year of practical that people do with us, of course, teaches them a great deal about laboratory work, project planning, all the aspects of technology and all the aspects of design and interpretation of data and, probably of major importance these days, a considerable exposure to computers and information technology, which is again a significant area where I believe the universities are letting science students down. On the basis of our experience of taking on people who have graduated without a sandwich year, or those with a sandwich year, or alternatively I know for example that Oxford offers four-year degrees and there is a lot of practical work, there is a real difference. It is very attractive for us to recruit students who have done this extensive practical training in sandwich years.

Lord Craig of Radley

728. Dr Paul England, I have to be the devil's advocate here slightly. You talk about lack of funding in a number of areas and that inevitably leads to the question, assuming there is not a bottomless pit, as to whether we are trying to do too much training and taking too long over degree courses or trying to train too many people. If one were to approach the problem either of those two ways, what from the pharmaceutical industry's point of view would be the effects of that?

(*Dr England*) We actually discussed this earlier this morning and there is quite a strong feeling that a reduction in the courses that quite large numbers of people take would be appropriate if additional money could be used for longer courses for a number of specialist people who are going to become professional scientists, engineers and technologists. At the moment everybody does a three-year degree basically (or perhaps occasionally a longer one), and for quite a lot of people I am not sure that the final year is particularly important or relevant for the job they are going to go to. So the money saved running two-year courses could be put into fewer four year courses. One model that certainly has been suggested is that everybody, perhaps 70 per cent of the population ultimately, certainly the 30 to 40 per cent now going into higher education, should do a two-year course. At the end of that period there should be rigorous selection, and ask people to consider what their careers are going to be. That is one way of dealing with a fixed pot of money. There are a number of diplomas and options with which I know a certain number of universities are experimenting in this way.

Chairman

729. Has this been explored with your professional bodies who have education committees and who have quite an influence on what universities do?

(*Dr Kipling*) This matter has been discussed within the ABPI and we have also spoken to a number of groups such as the Royal Society of Chemistry and the Biochemical Society. I think there is quite a lot of interest in the professional bodies in making a four-year degree course compulsory for a professional scientist. The idea of two-year degree courses has not however been discussed at length, but is one of the ideas under consideration at the moment. I have to say there is concern within the pharmaceutical industry generally that within three-year science courses there should be sufficient funding available to enable at least a basic amount of practical training to be given. People feel it has gone too far and that practical skills have declined too much in many of the three-year courses. Some remedy does need to found. It is not just on the animal research side; it also affects subjects like chemistry where the basic equipment is missing.

Lord Phillips of Ellesmere

730. To put it another way are you really saying that the shift that we have seen towards a mass higher education system has had a deleterious effect on the type of students you are looking for?

(*Dr Elves*) My Lord, that is exactly what is happening. We are facing a dilemma in the United Kingdom at the present time because we are split between wanting to have a scientifically-informed and literate community but at the same time having

[Lord Phillips of Ellesmere *contd.*]

a high-level, well-trained group of professional scientists, engineers and technologists. What we are producing is something which is missing certainly the latter objective. As Paul England has said, we need to re-think a lot of the ways in which degree qualifications are handled and awarded, and the sort of courses that are presented. Simply extending a science course to everybody who takes it for a fourth year could, if we are cynical, be looked upon as a way of wasting more money on people who do not need, or want or will ever use, that extra training. On the other hand we do need to have scientifically aware lawyers, accountants, bankers, and teachers even, as well as technicians. Our industry is suffering at the moment from a severe lack of good technicians because these people are now doing these degrees and are not getting the good technology grounding that we look for in our laboratories. Somehow or another we have got to re-organise our degree structure so that it will meet both objectives and, as Dr Kipling has said, invest the money that is available for practical science in those individuals who are actually going to benefit and also return benefit to the country and the organisations they work for. That is by the investment of that money available in really high level practical science skills.

Chairman

731. Could I ask you a further question here? Of course, the notion of a two-year degree is not a new one. It was current 25 years ago and Professor Pippard of Cambridge was a very powerful advocate of it. Do you think though that both these kinds of course, the two-year course serving the general body of those who come to universities (and presumably there will be a higher proportion of the total population of universities who would then have some exposure to science under your criteria) and the specialist four-year course—you said four- year course and I will accept that—to give them practical skills and extra knowledge? Do you think both those kinds of course can be conducted in the same higher educational institution or do you think that will lead to confusion?

(*Dr Elves*) That is a very interesting question, my Lord, and a highly contentious one. The obvious answer is there should be horses for courses and the new universities would have a very clear role in providing the first sort of education, because in essence that is what they have been doing for quite a long time. Some of the civic universities, on the other hand, are much better placed to deliver the specialist training.

(*Dr England*) Perhaps just one comment though. The danger of having it in different institutions is that we would have to have a system that allowed transfer at the end of that second year, otherwise you are asking people to make decisions at 18 as to whether they want to stay in as professional technologists and scientists.

Chairman] Modularisation and credit transfer is on the way at least, is it not? We have dissected the higher educational system, now Lord Renwick wants to come in.

Lord Renwick

732. Can I go back to Dr England's comments about sandwich years, just for my own interest, and ask him to elaborate on where sandwich years are available and in how many universities? Also you mentioned IT training. Surely most graduates are *au fait* with computers and computer-literate? Is that a real problem? Could you elaborate on that?

(*Dr England*) Yes, my Lord. I will take the issue of numbers of courses offering sandwich years. This has increased considerably in the last five years. I cannot tell you the numbers per subject; it differs a lot. I do not know the number of sandwich students as a total. As a company we take about 100 a year from four-year courses. That is just one company. Some courses such as chemistry traditionally had rather more sandwich courses, but it is something in the last five years that a number of universities, particularly the older civic universities, in the past never had sandwich years, have introduced as options. They are not necessarily compulsory. A number of universities do select students that they will allow to go on sandwich courses. These are the people who are seen to have the potential for First and 2:1's, the ones who are likely to become professional scientists. These are selected now. That is quite important because it does allow us to offer better quality projects and we can give more freedom to the design of them.

(*Dr Elves*) There can be a confusion if we call all of these arrangements "sandwich" courses. The old Polytechnics and the universities that came out of that sector some years back, like Bath and Brunel, have continued the sandwich tradition. The civic universities, in our experience, were very resistant to the sandwich course. What our company did about five years ago was to introduce an Industrial Trainee Scheme which we extended to the civic universities for them to select, not a whole year of students, but one or two students from the end of their second year and send them to us for an industrial training period. That we believe is the way forward for the future. If all universities were to run sandwich courses, in the old poly sense there is no way that industry could accommodate the need. But we do find that increasingly now the civic universities, and even Oxford and Cambridge, are sending us their best students for a year. Glaxo, like SmithKline, takes on about 100 of these people a year into our laboratories.

Lord Phillips of Ellesmere

733. We are talking about undergraduates and not CASE studentships?

(*Dr Elves*) Undergraduates.

734. Can I ask what the career development of these people is? Are they destined to become research leaders or in fact are they more technically inclined?

(*Dr Elves*) It is very difficult to generalise because they are all individuals. Certainly in my own experience one of my former heads of department, who now works with another company as a divisional director, was a sandwich student from Brunel. Certainly these students are sought after by industrial research managers. Our managers will tell

[Lord Phillips of Ellesmere *contd.*]

you they are undoubtedly worth having. They are head and shoulders above the conventional undergraduate graduating from a traditional course.

Chairman

735. Is that long-term potential?

(*Dr Elves*) They have an awareness of the technology, for a start, and often they have had a lot of experience of very sophisticated state-of-the-art equipment, which they never get to see in their home university base. They also work on industrially-related projects. We put them into project teams with research scientists in the organisation; so they get real experience of what research is. They are very well aware of that. They are also intellectually much sharper when they go back to the universities. This is the universal comment we have always had from our academic colleagues when they take these industrial trainees back again; they come back as reformed characters.

(*Dr England*) If I can make one point, my Lord Chairman. I would not like us to leave the impression that these people are just going to come back into industry as graduates. My own experience is a number of them have gone on to do PhDs. The sandwich year has actually reinforced their wish to become full-time scientists. I would not like the impression to be given that these people are just getting a technical training and they stay as graduates and come back in at that level. A number of the ones I have taken on in the last few years have gone on to do PhDs.

736. We have not touched on our main theme yet but there is one point we can get out of the way quite quickly. If you were to have your ideal scheme of two or four-year courses, sandwich or otherwise does not really matter, you would not want the Master of Research at all?

(*Dr Elves*) On that, my Lord, we are divided! My own personal view—and this is not necessarily the ABPI's view—is that the MRes course will find a useful niche. Its niche will be different if we had good undergraduates being produced from the universities who are laboratory-competent. As we said in the Glaxo submission to this Committee, the MRes could offer a wonderful opportunity for the re-training of the woman returner; bringing them up to date in science. The four-year degree scenario would change some views on the MRes but it is still worth exploring.

(*Dr Brady*) I think it is worth commenting that we have now a number of four-year degrees and perhaps in five years' time we will get enough evidence from the four-year degrees and from the MRes to be able to decide what is the best way ahead.

737. You approve of the pilot scheme being carried out?

(*Dr Kipling*) Yes. In collecting views from all of our member companies that was one area where there was general agreement. We have welcomed the pilot scheme. There was much concern within the industry over the idea of the MRes being a compulsory pre-PhD year. There may eventually be a need for the MRes on the basis the present three-year degree is not sufficient. Companies may choose to take on MRes people but instead of graduates. It depends what comes out of the pilot course. We look forward to seeing the outcome.

738. One final question; you have been emphasising practical skills as being lacking and you also said there was a lack of curiosity. I do not know what was meant by that and how important it is to industry. It is in your papers. Are you saying that the universities quench the curiosity which is the natural endowment of their entrants?

(*Dr Brady*) I think we were talking more with respect to the PhD. One of our criticisms has been the lack of curiosity and it is one of the things we would like to see restored to the postgraduate degree. Perhaps this is more relevant to the PhD than necessarily the undergraduate.

739. When I have seen the old teutonic organic empires which you would so much like to have, I have seen students totally extinguished in their curiosity so indeed, as you know, has Bernard Langley. Do you agree?

(*Dr Brady*) I agree.

740. This does not fit in with the notion of team work if team work is repressive.

(*Dr Elves*) What normally happens in the industrial laboratory, if we are honest, is that in addition to the project to which the team is committed a lot of "under-the-bench" work goes on as well.

741. Under the bench?

(*Dr Elves*) Under the covers.

742. I thought this was a new technique!

(*Dr Elves*) It only emerges into the light of day if it looks as if it is going to lead us somewhere. That is generally not discouraged. It keeps the curious scientist enquiring, and also contributing to his main project. Often the two go very much hand in hand—the one adds to the other. One of the traditions or ways of working in the industry laboratory, of course, is that the industrial research scientist will very rarely find himself committed to the same project for most of his life, and will be required to change his scientific interest within his broad discipline at least once or twice during an industrial career. This is generally a way of broadening the individual because he brings in something of the experience he has had in the past to the new areas as well. In the academic environment, and I was for 16 years an academic before joining industry, the need to have a publication record in order to be successful in career progression, and in obtaining the next grant, actually goes against too much divergence from your main line of research. You have got to become an expert in that area.

743. I think that brings us neatly to the major question we are facing which is the problem of these contract researchers on which I know Lord Phillips has views. If I could anticipate him by one question which is this: what you have been enunciating is something which can happen very easily amongst these contract researchers, namely that they will play safe in their research topics to get publications which may mean a diminution of adventurousness and

[Chairman *contd.*]

originality in the kind of work they undertake. Is that your view?

(*Dr Elves*) My Lord, if I can give you one practical example of how this operates. If we go back into the late 1950s when Professor Gowans at Oxford and his colleagues laid down the foundations for modern immunology, they hardly published anything until they got almost the whole story upon which modern immunology is founded. Had they been working in the 1980s they probably would not have got a grant beyond their first one. We are very worried about the short-term nature of post-doctoral fellowship research outside of the special schemes of, for instance, the research councils and Wellcome. We operate three-year grant schemes for collaborative research, not contract research, and we find these by and large are not as useful as they could be for the simple reason that the amount of work you get out of the three-year period is certainly not three years. The post-doctoral scientist employed on the project is often looking for another job, certainly during his final year and, if he leaves before his full three years is up, it is virtually impossible to get anybody to take on the remaining part of the grant. The three-year cycle is a very stifling arrangement. It also pushes the academic into looking for projects that give him a good lot of publications while he is at it. In our company we are moving more towards programme grant systems and giving academics five-year funding for some of our major collaborative programmes. We are finding these allow very much more imaginative science to be done because they are under no pressure to publish in order to keep their money coming from us.

Chairman] This is a natural point for the former Chairman of the Advisory Board of Research Councils to come in.

Lord Phillips of Ellesmere

744. Can I start by saying I was interested in your anecdote about Professor Gowans. I would take a slightly different view of that. It is my view that he worked on a problem which was suggested to him by his patron, Lord Florey, and it was Lord Florey who provided the support for him and as he went on with it I guess as long as Lord Florey was alive and kicking he would have continued supporting it. Patrons have a great role to play in academic research. Again that has been under-estimated. I agree very largely with much of what you have said. I would think the research assessment exercise carried out by the funding councils is a pressure towards short-term results. Having said all that, let us come back to your point that increasingly your industry, and I suspect some others, will rely for general exploratory work on the work that is done in the universities. The friendly way of saying that is that is the sort of work that universities do best. The unfriendly way of saying it is that is industry out-sourcing its work because it cannot afford to do it in-house any longer. Whatever the explanation is you will be depending on universities. So what we desperately need to know from you is how do you see university research being better organised to fulfil the role nationally and in relation to your industry that you think it needs to play?

(*Dr Elves*) I take your point about patrons. What we would like to see is research councils and other bodies acting as patrons. The way that we are organising our research and out-sourcing is nothing to do with us not being able to fund research in-house. There is no question; we do fund a very significant amount of basic science in company laboratories. The principal reason why we put basic underpinning research out into collaborative arrangements with academic groups is because they are the ones who have got access to the diseased abnormal clinical material and clinical and para-medical know-how. Our companies cannot have this in house because we cannot run hospitals, and we do not really need to have that expertise on board all the time. It is very much a symbiosis; it is not a parasitism that we are talking about here.

(*Dr Brady*) As technology develops all companies are going to need, my Lord, to access technology not just from the United Kingdom but increasingly from the American universities and no company can afford to research and develop. Increasingly we are forced to out-source with the academic community.

745. So how do you want to see the academic environment organised?

(*Dr Elves*) By less reliance on publications and more reliance on career progression in academia by management. We do not promote our scientists on the basis of how much they have published in the last 12 months or 3 years. We promote them on the knowledge that their manager has of their skills and their contribution to the overall research programme. This allows us to take a longer-term view of programmatic research. I think an obvious way forward is to move away from, for instance, the three-year grant structure and have the Research Councils arrange for collaborative research programmes that are over a much longer term, but are *managed.* Some of the LINK programmes in the early days did this extremely well. They brought together a number of partners and that is another important facet. We cannot do research any more with the odd scientist here and there. Very often we need to construct teams and we need to construct them from people in very different organisations sometimes, and that does need management. Where the LINK programmes we have been involved in have not worked is where the programme has failed to put in a person to hold it together: a manager who knows the people who are working on the programme, who knows what they are doing and acts as a conduit by which information is channelled around the system. In Glaxo we operate one such programme in the tuberculosis area. That covers research workers in three UK universities and four universities in South Africa, plus our own in-house team. That programme is working exceptionally well because we have got a dedicated person, a scientist, in charge who manages the whole thing, creates relationships and knows his people. We are not judging their performance on what they publish; we are judging their performance on what they produce along the lines of realising the objectives set for that programme which are very clearly defined.

Chairman

746. That brings us back to the real difficulty. I understand all you say, particularly in relation to an industrial enterprise especially in the pharmaceutical sector, but universities have a duty to the future which is that the seedcorn of the future should not be neglected. There must be room in universities, surely you will agree with this, for the unknown, the unexpected, the original curious able person to come through and this will not happen if it is too managed or managed in a teutonic way.

(*Dr Elves*) That is a criticism we often hear. What we are not saying is that the whole university system has got to be run in this managed way. What we are saying is a significant amount of Research Council funding, for example, ought to be directed in this sort of way. We must preserve the curiosity and we must preserve the blue sky. We are becoming increasingly concerned about whether we actually know what blue sky is.

747. We have got this mass in the last 15 years of contract researchers which has quadrupled in number whilst the academic staff have stayed stationary. That is broadly the position in science, engineering and technology added together. There are variations between the three but that is a summation of it. What would you now do with this situation? Would you regard it as satisfactory, that it will resolve itself in ten years' time as the aging professors disappear from the scene or do you think special measures should be taken and, if so, what.

(*Dr Elves*) I do not think the situation is going to change much. There are too many benefits from the employers' side in maintaining the short-term contract system. We do have an ageing population within academia. This is something we have touched on in our written submission. I am not encouraged that the short-term contract system is going to disappear. I think something should be done about that.

748. In that case you have got to manage them better.

(*Dr Elves*) I think we need to. The move towards where we are encouraging five year support for grants is an example.

(*Dr Brady*) We would hope, my Lord, with the advent of Foresight we would have perhaps more direction to the science and the areas we would wish to progress. As a result of this teams could be brought to bear and activities could be highlighted and initiatives could be undertaken. I think there is a opportunity for a new strategic thrust with respect to United Kingdom research which perhaps was only there in part before.

749. In fact you would have the same total number of people really but most of them would be on longer-term things connected with targets which could be determined by Foresight?

(*Dr Brady*) I think this is what we would like to see. This would mirror the activity of companies supporting short-term research.

750. How would you protect that basic part of science which must be preserved which by its very nature is unknown where you are relying on original minds to go in their own wayward directions? Who holds the balance in this?

(*Dr Brady*) Is this not more about providing good people with opportunity and good furnished laboratories with a longer-term perspective?

751. Their own ideas are you meaning?

(*Dr Brady*) In some degree yes, but in strategic areas which have come out of this Foresight exercise. I do not think we consider this should be done too prescriptively.

(*Dr England*) I think, my Lord, there are some models already in certain university departments where the department has been actively managed and it has just two or three key areas on which is working where good people have been brought in, given money and independence and they have the opportunity to let the new ideas surface because they have a longer-term view. I will not quote the individual departments here but I know of a number where this has been a deliberate policy. The department has not been allowed to grow by some process of osmosis or just by pulling people in. It has been very definitely managed and these places stand out as being world-class because of the individuals. They have been actively managed and yet new ideas come through. If someone has an original idea they go and do it.

752. Is that true? I have heard many criticisms to the effect that they become lop-sided, they do not cover the subject, the range of work there is really unbalanced in relation to what other universities do and they are personal empires.

(*Dr England*) My Lord Chairman, I feel that yes that is true; it depends on the particular department. What I would like to do is quote you the best. You are probably quoting me reasons why a number of them are not that good. It is partly to do with size as well; a department needs to be big enough so the whole department is not in one area, it needs to be in two or three areas.

Lord Phillips of Ellesmere

753. You have emphasised the importance of teams in modern research which one might almost say is in a mass production phase in some areas. These teams at any one time will include people who aspire to be and succeed in being research leaders themselves as time goes by. No doubt they will include people who aspire to that but will not succeed in doing that. They will include some people who are essentially senior technicians, research assistants, who are going to be very good at a limited range of techniques that are important to a team but are never going to direct team activities. I would agree all that needs managing. Would you see your model of having rolling contracts, where people can be given notice at a particular time, an appropriate model for universities to follow?

(*Dr Elves*) The universities are not industrial bodies—quite obviously—and different conditions have to apply. There are some university departments who do regard themselves as industrial bodies in the way they behave. From the industrial perspective, certainly in our teams, we have all of these sorts of features and characters you have just described, and the system does work. In the university system one has got to have a career progression that takes the individual, perhaps out of

[Lord Phillips of Ellesmere *contd.*]

the team working in research environment, into other roles within the system. We have been talking, so far, about the bottom end of the system, if you like—the hands-on research people predominantly. We are forgetting in our discussion about the academic staff—the permanent tenured staff—and we need to have a career progression that will take the rolling scientist into that sort of career progression, if he is capable of so doing. Also, we ought to be giving him training to allow him to do that because we do not, in our context, push people into a team and leave them there. Training is being done to expand them all the way through the system. Universities need the same sort of thing. Post- doctoral scientists ought to be seen in a similar light to how one would see junior hospital doctors. In other words, they are training jobs. During the post-doctoral period, that training ought to be continued. Eventually, the ones who are going to make it will realise they are going to make it and, hopefully, the ones who are not, will be encouraged to realise it—if they had not realised it themselves. This is also what happens in the medical field.

754. Is there a responsibility on the university to help those people who are not going to make it, to recognise that and to find a different role?
(*Dr Elves*) I would say, almost certainly, yes.

Chairman

755. I am conscious of the fact that we have to see the Royal Academy of Engineering and we have not touched on some of the points on the piece of paper in front of you. May I ask whether you would like to comment on any of them, and have you anything to offer specifically, just running through them quickly. Question one: we have not asked you whether the situation is different in other countries—and you know, of course, because of your worldwide connections—whether we have anything to learn from other countries.
(*Dr England*) In the American context there is no doubt that graduates in this country are, on average, still better trained than the graduates in the United States; and this is quite clear in terms of the type of job that we bring them in for, and the type of progression that they will make in their careers. But it is accepted in America that a BA degree is basically just training and education, and that it is the Master's qualifications that you will go on for. Within Continental Europe, my experience is limited to France and Spain, and I have been very impressed with the quality of graduates that we have recruited because it has been high. I have not personally had to recruit them, so I do not know the total pool that we were picking from, but from out of the ones we have picked, they are equal in standard to graduates here. I think the situation in the United States is that because it is a different type of education system, expectations are different.

756. All of them are older.
(*Dr England*) Yes.

757. More mature?
(*Dr England*) Yes. By one or two years at least.

Lord Craig of Radley

758. Would you include, in that general perception, that the good ones have got better communication and organisation skills, and are better team players; and, if so, do you associate any of that with the type of course, or period of training—accepting, as I imagine you do—that those skills are very important to making a successful research team leader.
(*Dr England*) I am afraid, my Lord, I am not quite sure I can answer that question from my own knowledge.
(*Dr Kipling*) In the review the ABPI carried out on what should go into a MRes, we identified people's views on the need for team-leading, team-building and communication skills. Most people thought that communication skills were an essential part of any degree—even for undergraduates—because they are natural "life skills". But there is a general view that team leadership training should not form a major part of any research based study. These should focus on the understanding of the science, with communication skills being a natural part of it.

759. In the periods of time spent whilst they are doing their research training, has enough time been allowed for other activities outside? Whether it is playing sports or drama, the debating society or whatever, all of which can make a contribution to these personal skills.
(*Dr Kipling*) We would support that. Also, one of the criticisms of many PhD grants is that the postgraduates are in very small departments, where there is not the support or interaction with fellow students. A major criticism is that many students are left to their own devices and cannot develop networking skills.

Lord Phillips of Ellesmere

760. I think when you say the American system is very different this is clearly so, but do you not think that, in some ways, in moving towards a mass-educational system, that we have been moving towards the American system without following it through?
(*Dr England*) Yes, very much, my Lord.

761. And, having said that, it would be my experience that when you get to the postgraduate—particularly the post-doc. level—the American post-doc. is at least the equal of the United Kingdom post-doc. and, at the same time, is more forthcoming and articulate.
(*Dr England*) My Lord, I can actually give you a number of correct examples to that because I had to chair our internal committee looking at our promotion structure, and one of the major debates we had was the level we brought PhDs in—in the United Kingdom and the United States—the United States was one grade higher than that of the United Kingdom. This was recognising the extra skills they have—apart from the fact that they are older—but there is the additional training, particularly if they have had a four-year undergraduate degree which allows a broadening of certain skills; then particularly the training year, which was the

[Lord Phillips of Ellesmere *contd.*]

rationale behind the MRes. I do not wish to reiterate, but there were a lot of positive things about the MRes. It was just that we felt that if there were going to be any priorities, it would have been better to have had better graduates. However, to go back to your point about the American PhDs and post-docs., I think they are more mature and better. I would agree with you.

Chairman

762. But can they write?

(*Dr Brady*) As long as they have a spell-check and a grammar book.

763. I have had a lot of American post-docs. and pre-docs. too and the one thing on which they fall down is their basic literacy and inability to communicate without gesture, if you see what I mean. May we touch on one question before you go, which does concern us, and that is that women in this group of contract researchers are at the bottom of the heap. We are not using the potential of those women scientists and this may be having a feedback and a deleterious effect on women coming into science. Have you got any experience which you can give us the benefit of?

(*Dr Kipling*) I can only comment on the pharmaceutical industry where companies appear to be doing as much as they can in looking after women scientists. It will be extremely difficult in academia however because it comes down to a cost matter. I anticipate that it would be very hard to manage a scientific career and have a family, and obviously there are cost implications for universities in trying to manage creches and child care facilities. There may also be tax implications of such schemes. But we may be seeing a change within industry and academia. We are seeing a higher profile of women scientists, which is a good thing, and is how it should be. From talking to our member companies, they all have schemes in place. Many have creches or return to work schemes. Some have schemes so that the women can keep in touch when they are on maternity leave. I think we are doing as much as we can[1]. I think our industry is particularly enlightened compared with other industries, but as far as the academic side is concerned, there are still major problems there which I think come down to cost.

(*Dr Elves*) One of the things that could be done for the woman scientist who goes off to bring up her family, is that she could be given an opportunity to keep in touch with science and the way it develops, by giving them part-time teaching contracts within their HEI. That would keep a foot in the door and keep the interest alive. One of the problems that the academic woman scientist has, which is not necessarily one the industrial scientist has, again comes back to the publication issue. After two or three years out of the publication game, she is at a severe disadvantage over her male colleagues. Again, as Dr Kipling has said, many of our companies do run schemes to encourage women back into the lab. by providing whole-time creches and other facilities (and sometimes financial help); but there are also other things like part-time working, and like job sharing schemes; which are adaptable to a university environment with a bit of thought. They certainly do help and in Glaxo, for instance, in our senior management hierarchy, department heads and downwards, getting on for 17 to 20 per cent of these positions are now filled by women scientists. So it can be made to work.

764. I fear we must draw this to a close. We could go on for much longer obviously. Is there anything we have failed to elicit from you, either in the memorandum which you gave us and the appendix, or from anything which you have said today, which you would like now to tell us about or possibly submit in a further memorandum?

(*Dr Elves*) I think we have covered the ground pretty extensively in our formal submissions, and also in the discussions in which we have taken part with you this morning; unless any of my colleagues want to say anything further, which they want to raise?

(*Dr Kipling*) We will certainly submit further evidence, should further issues arise on which you want our views.

Chairman] Thank you very much for coming.

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[1] See supplementary memorandum.

Supplementary Memorandum by the Association of the British Pharmaceutical Industry on "Women in Science"

Although the ABPI believes that there are in general more encouraging signs with respect to this topic, there is one further issue which we would like to raise with the Select Committee. It does appear that even the more able women do suffer a loss of confidence once they seek to return to the academic envionment after a period of leave due to child/children or family commitments. This in part may be due to the increasing pace of research evident today. Some part fellowships have been introduced to help with this issue. However, more still needs to be done and the Select Committee might wish to consider if this initiative should be referred to the Research Councils or HEFCE for consideration. A one day per week teaching fellowship for a year or so may be a good way of "easing" able women researchers back into the academic system. It gets them back in touch with scientists and science, helps with self respect and allows them to decide if they wish to return full time to academic research.

Memorandum by the Royal Academy of Engineering

Short-term contracts are of great value to universities – flexible, adaptable to changing needs, and in most disciplines attract good recruits. But to the individual employed on them, while they offer good experience, they offer no security and little promise of a permanent appointment. The "bulge" of academic staff due to retire in about ten years' time will provide opportunities for new permanent appointments. There is greater mobility of engineers than scientists between academia and industry; existing initiatives should continue to be supported. The proportion of women in science and engineering will increase slowly but surely: actions to make careers more attractive apply to both women and men. The MRes as an obligatory preliminary to research is not supported.

Question 1 What are the advantages and disadvantages of the current career structures for academic scientists in the UK?

We distinguish between academic scientists and engineers in permanent posts and those on short term contracts.

The advantages of an academic career in a permanent post include contact with bright and interested students and like-minded colleagues, and a degree of freedom to pursue research and professional interests.

The disadvantages include the effects of increasing student/staff ratios – more time devoted to teaching leaves less for research – and the increasing administrative load in preparing for formal assessments and in making research applications.

However, those on two or three year research contracts have fewer of the advantages and more of the administrative disadvantages, compounded by lack of job security.

Particularly in engineering, there is a significant differential between academic salaries and those available to the same individuals if they work in industry. This is especially marked in chemical engineering, and The Academy runs two programmes, funded by industry, which help to recuit and retain able young engineering lecturers by means of a salary supplement.

The age profile of current academic staff is another problem. In many disciplines, there is a "bulge" of staff who will retire in about ten years' time. In spite of "new blood" initiatives, there have been comparatively few jobs for young academics over the past twenty years.

Question 2. What are the advantages and disadvantages of the growth in short term research contracts in academic science?

The advantages of short term contracts for a university are that the most suitable people for a specific project can be employed, without a commitment to their longer term future.

The disadvantages are that there tends to be a lack of continuity, expertise may be lost, and the people employed may have a reduced commitment to the project, especially as they spend time looking for their next posts.

The major disadvantage of the growth is that the number of people on short term contracts is out of all proportion to the permanent posts which may become available. This is demotivating to the people involved. The scale of the problem is described by the situation at one university in July 1994.

Discipline	*Permanent Academic Staff*	*Short Term Research Staff*
Medicine	136	159
Biological Sciences	48	70
Science	117	124

Engineering	162	203
Total	463	556

There is a slow turnover of permanent staff, and fast turnover of the higher number on short term contracts, with no evidence of any significant difference in the quality of these people. There is such an imbalance that there is little hope of logical planning. Some on short term contracts will go into industry or academic posts, but many will reappear in a year or two on another short term contract.

An additional factor is that the value of research studentships and the salaries for research assistants have fallen so far behind the salary of a graduate in industry that few of the best home graduates apply. Increasingly, funding is subsidising the research training of overseas nationals who will return home.

Question 3. How do you expect the situation to change in the next decade?

Towards the end of the decade, there will be increasing numbers of retirements of permanent staff, which will make room for more new talent (those newly appointed will be at a lower cost, one-for-one, than those they replace).

Universities appear to be becoming more flexible about salaries, and we expect this trend to continue. There may be a greater perceived range of quality of universities (as in the USA).

The concentration of research in universities is likely to change, but this will be determined by government policy as implemented by the Funding Councils and the Research Councils.

Question 4. What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?

We do not have any information on their destinations. Individual university departments may hold such information.

Question 5. What should be done to improve the mobility of scientists between academia and industry?

We believe that there is considerably more mobility of engineers than of scientists, both through the variety of postgraduate training schemes (including the Teaching Company Scheme and the pilot engineering directorates—EngD) and in the case of qualified researchers.

The concent of mobility includes both semi-permanent transfers and short term or part-time appointments. Programmes such as The Academy's pilot Industrial Secondment Scheme and the large scale scheme of Visiting Professors in Principles of Engineering Design have demonstrated the value, respectively, of short term and part-time appointments.

Short term secondments from university to industry leave a gap which is not easy to fill (although the increase of modular courses may ease this problem). In spite of this deterrent, such secondments are a valuable form of technical updating and technology transfer.

Question 6. How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attactive to women, and how?

From 1982 to 1992 the proportion of those entering engineering degree courses who were women rose from 7 per cent to 15 per cent. We expect the proportion to continue to increase gradually over the next decade. The problem is, to a considerable extent, a cultural one.

Academic careers are attractive to women (and to men) because of the comparative flexibility of working hours and locations as opposed to many jobs in industry. Scientific careers—whether in academia or industry—could be made more attractive to both women and men by more flexible working and by employers maintining links during career breaks. (We could learn from some of the High Street banks.)

Question 7. The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.

The Academy did not support the proposed introduction of MRes as outlined in the White Paper *Realising Our Potential* and amplified in the subsequent consultative document. We accepted the analysis of problems with the current PhD, but considered that these could be addressed by other means, including taught courses, within existing course lengths.

Many of the aspirations of MRes are being incorporated in the EngD experience, with its industrial concentration, and in many MEng courses.

Examination of witness

PROFESSOR ROGER WOOTTON, Dean of Engineering, City University, called in and examined.

Chairman

765. Good morning, Professor Wootton. Thank you for coming and thank you for being so patient. I am sorry we have kept you waiting, but perhaps hearing the discussion which took place before, has given you some idea of what we are particularly interested in. Also, of course, you have got the questions in front of you. The first question which is on there seems to suggest in its relation to your own submission, do you think the dynamics of the system will produce an amelioration of the situation in ten years' time or so. Is that right?

(*Professor Wootton*) You are referring, my Lord, to the note about the bulge of academic staff. It could be an amelioration if it is managed properly, but it will not be automatically an amelioration because we could end up with the same situation as we have at present, if the universities were to appoint—in replacing the bulge—another set of people all of the same age. So that is the first point I would like to make. The second point is, in fact, that engineering requires the transfer from one person to another, not only by reading material and papers, but also by use of facilities (and these days software) so that some degree of overlap between those youngsters coming in and those with experience is necessary; and that is part of the issue I regard as the management of the replacement of the bulge, which will come on and will occur with the bulge of retirements over the next ten years.

766. Do you manage these things well in the engineering departments, as distinct from the purer sciences that we were talking about with the previous group?

A. I should explain that I am relatively new to the academic world. I have personally been in consulting engineering for 25 years until returning just under two years ago to the academic world. So, to some extent, my personal view would be one of some degree of shock at seeing what goes on in the academic world as compared with industry.

767. A favourable or unfavourable shock?

A. Shock which is rather unfavourable in terms of personnel management. My colleagues on the Royal Academy who have involvement, both in industry and academia, would note that in industry there is greater thought given to succession policy, to the personnel management, to thinking about the careers. I would say that the Royal Academy welcomes the interest being taken by your Lordships in this very important topic. The Royal Academy very much welcomes the thoughts being given to this subject because this is an area that possibly has not been well considered in many universities.

768. Do you therefore endorse what you may have heard said by the previous group of witnesses?

A. In general, I endorse much of what I have heard over the last hour, yes.

769. Do you see that there are criticisms of the undergraduate courses which, in a sense, lead as a preliminary to this?

A. The undergraduate courses in engineering have to fulfil many different roles and you will, no doubt, be aware that the Engineering Council is, itself, reviewing the way in which university education feeds into the incorporated and professional engineering streams of the engineering industry; so that the engineering undergraduate courses have to feed both those people who will be in the engine room of the industry, as well as those who will be high flying in the managerial sense and have the breadth of experience to lead multi-disciplinary projects, as well as those who will focus on individual subject areas, hopefully leading the United Kingdom forward in specific areas of technology and engineering. So, to some extent, what you have heard about the pharmaceutical industry parallels that of engineering. But, as far as those who are going to go on into research are concerned, they may have, of course, to go on to management research as well as technological research which is relevant to engineering.

770. So engineering being closer, in a sense, to industry—to products and processes—has different incentives for the students and also for the staff in universities. Do you feel, therefore, that the engineering departments in universities are less subject to the kinds of stresses and strains of contract staff than they are in science and medicine?

A. No, I would say almost the reverse, because the problems are firstly encouraging British nationals to take an interest in engineering research in United Kingdom universities, because primary technology transfer is not by publication which is, as we have heard, a primary objective of all academic departments, at the moment, with the Research Assessment exercise coming on. But primarily it is not that. The primary technology transfer will be by people, by bright postgraduate students moving into the British engineering industry, and helping to create the wealth of that industry.

771. Is your concern for the fact that we have a lot of overseas students in engineering research derived from that point? Do you feel they are carrying their ideas out of Britain?

A. My personal view is one of shock at what I see in this area, I have to say, and I think that many engineering departments are very concerned about this problem.

772. But, of course, in a sense, in so far as the funding of universities is concerned, it is related to full-time equivalent students; there is an incentive for universities to balance their books foreign students, of course, bring a pot of gold with them.

A. Oh, yes indeed. That is why the universities are active in encouraging overseas undergraduate students; and so far as the postgraduate area is concerned, it is often difficult—with lack of continuity as well as the salary levels—to encourage British students to work on research contracts.

773. So that we are using overseas students for two purposes: one is to—if I can put it very crudely—help to balance the books of the universities; and the other is because British students are not available to carry

[Chairman *contd.*]

out the kind of research which engineering departments want to do?

A. We are not seeing as many United Kingdom students as the engineering departments would wish.

774. And your contract researchers: do they show also a significant proportion from overseas?

A. Oh, yes. In engineering, quite a few of them are, yes.

775. I am not thinking of pre-doctoral now but post-doctoral.

A. Quite a number are from overseas, particularly the Far East. In some areas of engineering there is, of course, a greater interest than there is in the United Kingdom.

776. So there is a genuine distinction here between engineering, on the one hand, and sciences, on the other? There is more of the overseas students and overseas post-doc. element?

A. I do not have the figures for science, but listening to Fellows in the Royal Academy of Engineering, I know this is a matter of concern: the problem of continuity of employment for good British postgraduate students and post-doctoral student fellows in British universities.

Lord Phillips of Ellesmere

777. I wondered about your reference to publishing papers and the research assessment exercise. You and your department must have this on your minds at the moment.

A. Probably too much, I think.

778. I think probably too much, but if not publications, what other evidence do the committees look for in engineering?

A. You have to take the broader picture of what is the contribution of that department to the United Kingdom engineering industry, as a whole. That may be by publications, or it may be by working with United Kingdom industry; either individual firms or with associations of firms, clubs, which I think, in many respects, is a better way for universities to work. By that I mean research associations, groups of industrial organisations. The problem that you are pointing to is the need to quantify into fairly simple terms a few numbers; for example, the grade of excellence of a particular university department in research. I have to ask whether that is absolutely necessary in order to put such a strong financial incentive based upon that rather than upon individual project work. If I look at my own department, it clearly matters a lot. I have one Grade 4 department and for that to move to a Grade 5, which is the next assessment, would make a lot of difference financially and so on; yet that effort might well be better spent in actually working on individual projects with industry which also—setting up the projects within industry—takes quite a bit of management time. That again has been rather underestimated in the present desire by the EPSRC that all research work in engineering departments should be related to United Kingdom industry. That is fair enough. but the amount of management effort required to link the objectives of particular companies and associations with the technology and the universities is quite considerable. To some extent you can either have that or you can have the research assessment exercise.

779. But the Engineering Assessment Panel, or the Funding Council—if I have the technology right—does take into account your relations with industry and contracts with them, as well as your published papers, does it?

A. We do not know the guidelines for the 1996 exercise yet formally, so I cannot comment on what is going to happen in that case. In the case of the previous exercise the answer was "somewhat", but there was still a very heavy emphasis placed on publication.

780. So this, in itself, is an inducement for you to maintain a large number of contract research staff, producing papers which will be valuable in the assessment exercise?

A. Correct. That is one of the targets of departments, which is not the same objective as supporting United Kingdom industry. No, it is not necessarily the same objective as supporting UK industry.

Chairman

781. In essence are you really saying that our funding mechanisms, both through the research councils—their system of estimating the quality of research which determines whether or not an extension to a contract or a grant may be made—or the funding from the Funding Council itself, with its heavy emphasis on the grading of the department research (there is some grading which in relation to teaching—of excellent, satisfactory or unsatisfactory—carries no financial penalties, as I understand it, or benefits) that the pressure is too great, greater than it should be that. That is to say, in order to get a proper balance of activity within the engineering field.

A. I think the Fellows of the Royal Academy involved with this would broadly agree with that statement, yes.

782. What do you see should now be done?

A. The key issue is the shortness of the period of contract of many of the very bright members or fellows in the academic departments. After all, these are the cream and we are supposed to be interested in encouraging them to contribute to the wealth of the United Kingdom industry; and to give them these very short-term contracts—sometimes two years, sometimes three years, and then not, in the formal sense, care what happens to them—is very serious. That gives the wrong impression to a youngster about the United Kingdom's interest in him or her as an individual.

Lord Phillips of Ellesmere

783. Presumably your university has a careers office? Do we understand from this that their principal interest and only concern is for the careers of people who leave after graduating?

A. No. In fact, our careers office—and I think it is true of most universities—do actually take quite an interest in postgraduates. That is not the issue.

784. And in post-docs.?

A. In the case of the post-doc., most of those talk with their supervisors directly about careers.

Chairman

785. Is there a formal scheme for appraisal of them and giving them guidance where they need it?

A. As far as I know, very few universities—certainly we do not—have a formal scheme, and it is the problem that they will have a shortish term research contract. They do not know whether that is going to continue, whether they are going to be supported thereafter, so by the time they get within a year or so towards the end of that contract, obviously they have to think either about looking for another job, or maybe an extension of that contract—sometimes applying for a new grant. That grant may not butt-end with the previous one and the university has to fund the gap in some way. It seems to be a very strange way of treating people who are supposed to be the very best engineers and technologists of the future.

786. Would it be fair to say that you are arguing for a longer contract term because that reduces wastage of people and money, compared with the short-term?

A. I am arguing for that for United Kingdom nationals. I would emphasise that this is something which could be given for United Kingdom nationals particularly, an improvement in continuity.

787. In this context how do you see women fitting in, since they are so badly disadvantaged at present. Perhaps the problem is even seen by you as a non-problem relatively, because the proportion employed is so much less in engineering.

A. The proportion employed in engineering, my Lord Chairman, I thought had gone up significantly.

788. Good.

A. In the last few years the experience that I have seen is that we are encouraging girls in schools to take a much greater interest in engineering and that is very much to the benefit of the United Kingdom as a whole. As far as the continuity argument is concerned, I feel again that is something which would benefit women who are interested in pursuing academic carers.

789. What was your reference to following the practices of the high street banks?

A. That was a reference to this business about the fact that their interest in personnel management, their interest in continuity of employment, their interest in succession policy, is very much better than what has traditionally taken place in the academic world.

Lord Phillips of Ellesmere

790. May I come back to a point which you have twice made when you say that these people are the cream. I think you are exceptionally fortunate if you are employing only the cream. There must be some people who you employ as United Kingdom post-docs. for whom you see a rosy future in careers in engineering in the United Kingdom, and others who it was perhaps a mistake to take on, or who are a useful pair of hands for the time being, but whom you do not see as having a personal career. Who gives them the advice on what to do and who makes the judgment?

A. I take your point. I was saying, to answer your question, that it is up to the academic departments; and I think you raise a good point here about the fact that sometimes universities are the refuge for somebody who does not feel he is fit to cope with the some of the rigours of the industrial world. But that person, that individual, may well contribute technically very well to a particular topic, in which case a long-term academic career might be the most appropriate.

791. But they may still not be destined for a leading career in academia.

A. That is right, but one of the problems in the academic world is that you only have a few steps. That is another thing which I found very strange compared with industry. You have only got the step from lecturer to senior lecturer, to reader or professor, so for many academic staff they will go through only two or three steps in their entire career.

792. So pressing you on this point a little, if I may, there is a need for career advice for these people. The supervisor, who you said was actually responsible for giving this advice, is actually an interested party in a sense. He may well be benefiting from the somewhat limited technical skill of some person and is therefore not all that willing to say, "I am afraid you ought to look for a job somewhere else." Does there not need to be an external arbitrator?

A. I think you will find these days that the heads of department play a much more managerial role in academic departments in engineering than perhaps their counterparts in some other subjects. I would suggest that talking to colleagues on the Engineers and Professors Conference, for example, which is a grouping of engineering professors and heads of department, that, in fact, most engineering departments are carefully managed in this sense.

Chairman

793. You are, as I understand it, individual cost centres now, are you not?

A. This will depend on the university, but many are moving in that direction. I do not think all of us are as independent as they would be in industry.

794. You heard the discussion which took place before. Have you any observations on the general thrust of the criticisms which were uttered by the Pharmaceutical Industries Group? Do you feel they are also true of engineering?

A. Yes, I do. We, as you know, did not support MRes, as proposed, because we felt that as it was not likely to bring with it any additional funding it would

[Chairman *contd.*]

be a constraint on the PhD system rather than a benefit, though the Royal Academy welcomed the thoughts behind it, that all people taking a career in research should be trained properly in the techniques of that research. On the whole, the Royal Academy supported the strengthening of the MPhil as a proper qualification, rather than as a failed PhD. On the other topics, many of the comments previously made would be relevant.

795. Yet most engineers I have talked to certainly would not share the view that there is much place for 2-year courses.

A. I know of no engineers who support the 2-year course in engineering for the professional engineer. The Engineering Council is considering whether that would be a suitable route for the incorporated engineer qualification, which is the technician level.

796. It is now considering it?

A. Yes, it is considering that. That would be the non-professional engineering qualification. It is indeed true that the United Kingdom needs to bring back some credibility into that level of engineering. However, if we keep to the professional engineer, then there is a strong view that the amount that needs to be taught properly fills a 3-year course, and for most students they would benefit from the 4-year MEng course.

797. Would that be true of the new universities that are coming in? Should they also be having 4-year courses?

A. Some have run 4-year courses for some years, but usually only with a small proportion of their students.

798. You are content, at the present time, that there is no danger of over-producing 4-year students who would be, in a sense, surplus to requirements?

A. For the 4-year students—in our case and in many others—the third and fourth years broaden the experience of the students into areas of management, and broaden the experience technically through the multi-disciplinary areas. Most engineering these days is multi-disciplinary. Whether you are building an oil rig or a windmill or an aeroplane, you are involved usually in more than one discipline, and 4-year MEng courses are a very good route into mainstream engineering. I do not think there is a danger that there will be an over-supply of MEng students.

799. Are there any points, which you would like to bring to our notice, which we have failed to bring out?

A. No. I think, my Lord, that I have covered all the points that we have noted in our submission and that you came back to us on.

Chairman] Thank you very much indeed for coming. We are most grateful.

TUESDAY 25 APRIL 1995

Present:

Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Haskel, L.	Redesdale, L.
Howie of Troon, L.	

Memorandum from the Royal Society of Edinburgh

1. Current Career Structures for Academic Scientists

(i) The present career pattern for academic scientists is characterised in its early stages by uncertainty resulting from short-term employment by way of post-doctoral fellowships, research contracts, research grants or temporary/short-term lectureships. Such short-term employment is largely a feature of universities and not of industrial or public sector research establishments which recruit those who have just completed a PhD or who are carrying out post-doctoral research to career grades with an expectation of long-term employment.

(ii) In the universities short-term employment in research lies outwith the formal career structure and there is little meshing between the two in terms of supply of, and demand for, qualified personnel.

(iii) University career structures, traditionally commencing with appointment to a lectureship and with an expectation of long-term employment, are characterised by low salaries, long salary scales, often very high teaching loads, low operating budgets, low probability of success in winning research council funding, and now, often by initial appointments to three or five-year lectureships. There are frequently inherent conflicts between time and energy spent in teaching and that spent in research and involvement in current management, assessment and administrative practices.

(iv) In the past all academics were expected to do the same sort of job which included teaching, research and administration, irrespective of their individual talents in these different areas. Some universities have increasingly separated these roles although permanent research appointments are still rare, and tend to be found at senior level, rather than throughout the career structure.

(v) Ideally, a young academic scientist should be following a career in a community dedicated to the pursuit of learning *per se* in which he or she has (a) long-term employment, (b) sufficient time to develop personal skills fully and to realise individual potential, (c) time and freedom to study, (d) opportunities to learn from and to assimilate the experiences of senior, experienced staff, (e) opportunities to participate in helping younger colleagues, including students, to develop and thereby be subjected to constant intellectual challenges, (f) access to specialised experimental facilities and the expertise to deploy these facilities effectively and efficiently, (g) opportunities to engage with professional colleagues in both national and international contexts.

2. Growth in Short-term Research Contracts

Growth in short-term contracts applies not only to those supported from research funds, but also to appointment of academic staff in general.

Advantages of short-term contracts to the institution are flexibility, for example, allowing those with a suitable background to be deployed in priority areas; retention of suitable staff on short-term contracts until permanent posts become available; facility with which staff numbers can be reduced at short notice in response to unexpected reductions in funding; ease with which individuals who do not perform satisfactorily or are clearly unsuited to a particular research activity can have their appointments terminated.

Short-term contracts may provide incentive to sustain high volumes of output and in this way may be a productive way of handling research.

Disadvantages arising from short-term contracts include emphasis on volume of output at the expense of quality of output. There is limited time for curiosity driven as opposed to goal oriented research. Preference is perforce given to short-term rather than to long-term research projects.

At a personal level, lack of job security may lead to low morale and constant seeking of other more permanent employment in science or elsewhere. Fixed term staff as a result devote a relatively high proportion of their time preparing grant and job applications. The insecurity of short-term contracts may give rise to difficulties in buying houses and planning families, and these may be exacerbated when both partners are career scientists on differing short-term contracts.

At the termination of the contract there is often loss of trained expertise, while research programmes may be considerably disrupted when an employee leaves before the contract ends.

3. Change Within the Next Decade

The general perception is that academic careers for graduate scientists will deteriorate in the next decade.

(i) Assuming that the imposition of "efficiency gains" continues as at present more time will have to be spent teaching, and further concentration of research funding, facilities and personnel will occur. Differences between and within universities in terms of the balance between teaching and research are likely to increase, not least because research assessment exercises can act as a lever to buy in scientists to the permanent staff who have lengthly lists of publications and have been on short-term research contracts.

(ii) Employment prospects differ because current age structures vary between subject areas and departments depending on levels of retirement and recruiting during the last decade, and because numbers of research students and staff on short-term contracts differ between subjects. In some areas there seems at present to be a reasonable number of vacancies with a corresponding number of well-qualified applicants most of whom are currently on short-term contracts. In other areas (mathematics was given to us as an example) there are few vacancies at present but many are expected later in the decade when an avalanche of retirals of academic staff will begin and there are likely to be few research students and staff on short-term research contracts to fill such vacancies.

(iii) There may be a highly competitive market for the best qualified scientists as a result of

(a) the cyclical international expansion in higher education;

(b) in the UK most attractive conditions of employment outside the universities, including terms of service, facilities for research and salaries;

(c) outside the UK, similarly, there may be increased facilities for research in other countries.

In addition more universities may set up Research Fellowship Schemes similar to those of the Royal Society of London, as Warwick and Leeds are doing. These may guarantee a lectureship or other permanent appointment after this tenure, which would reduce the number of posts available for open competition but would enable long-term planning to take place at both personal and departmental level. In the life sciences senior research fellowship schemes developed by the Medical Research Council, the Wellcome Trust and the Royal Society are creating an independent research career path within the universities that can produce at least a prospect of long-term employment. The standard for appointment to these posts is exceptionally high but they are making a significant contribution to maintaining the science base.

4. Destinations of Scientists

Systematic data are sparse. However, it is known that scientists leave the short-term contract sector for "permanent" careers, not always in the UK, as university lecturers, or as research scientists in public sector research organisations, or less commonly, in universities or industry. Some become school teachers; some train to become accountants or enter other administrative/managerial posts. A few are unemployed. Where domestic requirements are geographically restrictive, as is more often the case with women than men, the move tends to be to school or further education teaching in the local area.

5. Mobility Between Academia and Industry

Any mobility between academia and industry tends to take place once in a career. The fundamental reason for a lack of continuing interchange of people between academia and industry is that the goals of the two sectors are in the main inevitably different. As the two sectors have different reward systems based on different criteria—which is proper as the goals are different, continuing interchange leads to a lack of promotion (or praise) in either system. In certain specialised areas (medicine is one, engineering perhaps another) the goals of the two sectors are in sufficient accord for more interchange to take place. Perhaps as important as interchange of jobs is participation in joint research and development. The LINK scheme has led to a much improved understanding of industrial needs by the academics involved, and of the usefulness of academics by the industrialists. The curtailment of this scheme will be counterproductive for industry-academia understanding.

Improved schemes of sabbaticals for academics to spend time in industry could be helpful, although these might provide few publications to contribute to research assessment exercises. Some interchange from industry to academia occurs at senior level by way of honorary appointments, but this has little effect on people in mid-career. Schemes, such as the current ROPA award system should be encouraged, although this requires £25K from industry to start and should perhaps be assisted by a smaller pump-priming mechanism.

6. Women in Science, Engineering and Technology

Short-term appointments are not, in themselves a peculiarly woman's issue. The nature of much scientific research imposes strains on all workers—long hours, need for unexpected late working and attendance at meetings in the UK and abroad. When these strains are accompanied by the assumption that women will look after the children, a woman's issue does emerge. A lot more needs to be done in providing university creches, in structuring maternity leave, and in re-training upon re-entry into the university sector. Part-time appointments for both men and women need to be commonplace and accepted as normal. The percentage of female staff to total staff in science and engineering departments is still strikingly less than the percentage of female to total students in the same departments. The lack of role examples is a strong factor in the low percentage of female students in certain of the scientific disciplines. This can only be overcome by a conscious effort to make universities much more considerate of the needs of female staff in the areas indicated.

Other difficulties arise because women tend to move with their husbands or partners so that they are often more geographically restricted in their search for employment.

7. The Master of Research Degree

Support for the MRes varies considerably between disciplines depending on the precise nature of postgraduate work and the source of recruits to this. There is general concern that proper resources for the MRes are not being made available, and that funding for the MRes at whatever level, should not be at the expense of other postgraduate funding which is already inadequate.

Examination of Witnesses

Professor V B Proudfoot, General Secretary, Professor D P Lane, Professor of Molecular Oncology, Department of Biochemistry, Medical Sciences Institute, University of Dundee, Professor C D W Wilkinson, James Watt Professor of Electrical Engineering, Department of Electronics and Electrical Engineering, Glasgow University, Royal Society of Edinburgh, called in and examined.

Chairman

800. Thank you very much indeed for coming on this occasion. We are grateful to you for this memorandum which you have produced. We found it extremely interesting. Of course, it is very similar in many ways to information south of the border. I wondered whether you would like to say something at the outset, either in amplification of this or highlighting particular points that you feel particularly strongly about, and then we might go into a general elucidation of evidence by question and answer.

(*Professor Proudfoot*) We are not at all convinced that the system of temporary appointments at junior level necessarily produces the best science and that at the end of the day is what we are interested in. It may produce a lot of short-term work but it does not necessarily lead to good long-term research. I think that is a general comment which would be very widely supported amongst those with whom we discussed the problems.

801. Your colleagues agree with this?

(*Professor Lane*) Yes. I think it is particularly important that people see a good career structure in science. If there is a discouragement to enter the profession then I think you will not attract the highest quality people. We are certainly not asking that everybody who enters at professional and junior level succeeds through to a permanent position. That would be a disaster. If the perception of your chances of success for whatever reason is too poor then I think you fail to recruit a good group to select from.

Lord Phillips of Ellesmere

802. My Lord Chairman, perhaps I could intervene straightaway because this point worries me. It seems to me that the entry into academic research careers, certainly since the 1960s, has been an extremely competitive process. It is almost inevitable that it should be. If I say to you that many are called and few are chosen, you may recognise that quotation and think that it applies in this case. There does, in my view, need to be some sort of probationary apprentice system in order to select out those that are ultimately chosen. How would you do that?

(*Professor Lane*) I agree with that very strongly. I think the MRC and Wellcome schemes that have been recently introduced have provided very good systems to help that process because they do allow people to progress further in their research careers with some degree of security so that they can then be tested, if you like, more fully. The difficulty at the moment is the lectureship post as it exists can be a very poor post for somebody trying to progress in an academic career because too quickly it can take them out of their capacity to compete scientifically.

Chairman

803. Problems competing in research terms?

(*Professor Lane*) Yes.

(*Professor Wilkinson*) I think the other point is that while the traditional post-doc aged 25 to 28 is very useful, it does prove a sieve for people going on into an academic career. A problem has arisen in that the number of lectureships has diminished and we have people at the age of 35 still on temporary

[Chairman *contd.*]

appointments and I think that is the crux of the problem. It is these older ones who now look unlikely to get an academic appointment.

Lord Phillips of Ellesmere

804. What gave them the expectation that they might?

(*Professor Wilkinson*) It was not necessarily the expectation that they might, I think it was more that they were offered more post-docs by people perhaps who let them go on into it. An awful lot here also depends on the sector, whether you are thinking of the applied sciences in engineering and possibly medicine or whether you are thinking of the very pure sciences. In the applied sciences it is possible to get people into an industry aged between 32 and 35. This has recently been proved by some of our very old post-docs and then I think we have actually done a good thing because the years of training will be very helpful for what they are supposed to do and what the company want. On the other hand, if you finish up with a very pure biologist at the age of 35 then that problem has arisen.

Chairman

805. I wonder if we might go back to the beginning because I think we have got into some detail before the broad pattern has been established. We have taken the old universities (by this I mean those who were there before the recent expansion of numbers) and chosen just to look at those simply because we want self-consistent statistics. If you look from 1976 to 1993, the number of staff in those universities has remained broadly speaking constant. Also, they were mainly, therefore, recruited before 1976. That means there is some hope for the future. They pass out of the system quite naturally. In the same period the contract research staff numbers have multiplied three-fold and four-fold for a slightly earlier period. It has not meant an increase but an actual change of magnitude. This has led to a large number of people, some of whom are over the 30 years that you were speaking of, who seem to have salaries which are very often not similar to those who are on the university staff of academically or chronologically similar status, if I can put it that way. There appear to be grievances about the status and the way they are treated by universities. When one looks at this in a crude, broad way you think that the present problem of the universities is difficult, but it is not going to get any better because nobody can see nowadays that there will be a greater unit of resource of full-time students provided either in Scotland or the UK, it would seem to me, so we have to live with this. Also, at the same time, there is an opportunity, is there not, for this bulge to pass through? Have you in the Royal Society of Edinburgh looked at this, as it were, in a statistical sense, sector by sector, to use your term, and do you see any great differences from the situation in the UK generally?

(*Professor Proudfoot*) We have not looked at this statistically, but I think the impression we have is that our engineering schools are very similar to engineering schools elsewhere; our biomedical departments are very similar to those elsewhere and face the same kinds of problems in general terms.

806. One thing that is mentioned in your evidence, which I have not seen before in relation to engineering, is, namely, that it is more difficult for an engineer who is wholly academic to become a chartered engineer.

(*Professor Proudfoot*) That is not in our evidence.

807. It is not in your evidence, it is in some we have had from the University of Edinburgh, if I remember correctly. Is that a fact?

(*Professor Wilkinson*) It is a fact because the Institute of Electrical Engineers requires two years experience after a first or a second class degree before you are chartered. Employment by a university only counts as half rate and therefore you have to serve your four years. This is something which quite a number of us have argued over the years.

808. So it is really a delaying effect if you continue in university employment?

(*Professor Wilkinson*) Yes.

Lord Howie of Troon

809. I do not think that applies in the civil though, does it?

(*Professor Wilkinson*) I was quoting the IEE because I know it.

Lord Howie of Troon: I am putting that in and leaving it there. The civils are looking for four years anyway, whether you are an academic or not.

Chairman

810. Perhaps we could come back to the quality question again. It has been said to us on several occasions that one of the problems arises from the fact that these contract staff are constantly moving on short-term contracts from one to another, so their mind is not fully on the job in hand whilst they are on a two or three year contract because they are looking for their next meal ticket, so to speak. Moreover, part of their eligibility to get another post relies upon number of publications which have become, in my view wrongly, a measure of their quality. It also says, incidentally, that they are not being carefully assessed by the people for whom they are working and that this has the effect of making them seek publishable research. In other words, it makes the original, exciting, problematic and risky research much less attractive to the person who is doing it. Do you think that is the case?

(*Professor Lane*) Yes, I think there are problems of that sort. In a three-year period it might take a year to get used to the system that you have moved into and then you might be looking for your next job when planning six to nine months ahead. The actual period of research in which you are engaged, being able to focus productively on the project, can be quite small. That is a concern. Some people overcome that problem by moving very much within a particular area so that their expertise is retained, but it is perceived as a problem.

[Chairman *contd.*]

811. Is it your experience that, in fact, as the system has developed the kind of work which is done is not of the quality that used to be the case or is it difficult to assess?

(*Professor Lane*) I think it is difficult to assess because in my area the field is moving extremely fast.

812. What is your area?

(*Professor Lane*) I am working in molecular biology of cancer and there is such a huge international effort put into that that the effort as a whole seems to progress well. But if you ask how efficient is each individual point proceeding then that is much more difficult to assess. There is a strong pressure to publish and I think that this creates a tendency to do short-term work and potentially to repeat or follow on very closely on somebody else's observation rather than try and break original ground.

813. The same problem exists in the United States and when we were in the University of Pennsylvania they told us there were genuine problems even in the fields which you have mentioned, that the pressure was on them no less than on other areas. What you seem to be saying is that the field is advancing so rapidly it is very easy to find publishable good work done even on a short-term contract. Is that right?

(*Professor Lane*) That is correct, yes. Because the technology has developed very fast so things that used to take a long time to do are shorter. If you wanted to step back slightly and say, "I want to take a long-term view of this whole problem", that is very difficult to do on this kind of short-term funding. I was recently reviewing one of the Medical Research Council establishments and there they were able to take—because they were an institute—a much longer-term view of a particular problem, recruit a number of scientists working in that area and try and develop a real body of knowledge and expertise in that area which I think is hard to do in the university system.

Lord Phillips of Ellesmere

814. Could we try to unpick this a little? The university in which Professor Lane is a distinguished research worker is notable for a research leader in the field of biology who has spent, say, 30 years elucidating the mechanisms of phosphoryeation and control. That is certainly a long-term programme which he has pursued with great success and no doubt with a lot of people. If we are talking about the research leader in that case, all these concerns about being confined to the short-term work clearly do not apply.

(*Professor Lane*) I think you have to look at the nature of the project. If you take that particular example, which is a good one, he has been able to publish continuously during the course of that project because of the nature of the type of biochemical measurement he is making. If you take somebody, for example, who wants to undertake a large project in developmental biology, it might take them several years to establish the system before it will bear fruit. There is a notable difference according to the type and nature of the work you are undertaking.

Chairman

815. Is it a problem of new entrants to a field?

(*Professor Lane*) In what sense?

816. Suppose you are in a university and want to do research in a particular field and you already have ideas but you cannot gain entry in that because you have no status when you are young; you have to become an apprentice to some master perhaps because the field does not exist already in something which is slightly different.

(*Professor Lane*) Yes, it is certainly true that in areas in which I work new people starting out find it quite hard to establish themselves because of the very competitive nature of the work and the large number of reagents that you might need to have in your core, if you like, in order to carry out the next observations. I think there is a difficulty in somebody leaving a large established research group to set up on their own to continue in that area because of the competition.

817. Yesterday Lord Phillips and I were at a celebratory meeting of the old Faraday Society and we were looking back over the years from its foundation in 1903. In the subject areas of which that is concerned, which are physical chemistry, chemical physics, electric chemistry and so forth, the pattern has always been one of the apprentice entering but not expecting always to continue; only a chosen few to do so. Is your subject one in which you would expect people to go on in that particular field as a career because the vast majority of these contract researchers have no hope of that, have they?

(*Professor Lane*) No. You would not expect to see the majority of them continuing. You would expect to see a sub-group continue. It is important to allow that sub-group to prosper.

818. The allowing of it to prosper is the responsibility of the research councils and the universities together, is it not?

(*Professor Lane*) Yes, I think it is.

Lord Phillips of Ellesmere

819. And also, my Lord Chairman, of the research leader. Is it not important that there should be research leaders, patrons one might call them, who do not expect the young person coming to the lab to start out a new programme all on his own but encourage him to set out on a programme where some pioneering work has been done that he can be helped into?

(*Professor Lane*) Yes, I think a critical part of the research leader's role is to guide the careers of those people who come to work with them and I think that is still seen to be very important.

Lord Redesdale

820. In the evidence you give of the majority of people who are actually not going to continue in this field, you say that they go off to teaching. Is that because that is the guidance they are given or is it because there are no posts in this industry for this type of work?

[Lord Redesdale *contd.*]

(*Professor Lane*) In my own discipline teaching is one thing that they might do. They might also go into other activities as well. It would not be the only area they would go into.

821. It gives the impression that teaching seems to be a first stop for many.

(*Professor Lane*) Traditionally it was an area where there was good recruitment. They were looking for scientists to enter the teaching profession, so this was a way that people could go.

Lord Howie of Troon

822. I would like to go back to a more general look at this. In your evidence in section 1(v) you describe an ideal career for a young scientist, which seems to me a very sensible paragraph, let me say, but it is not the pattern which exists in any way at all. I take that paragraph to be a very direct criticism of the existing system. I hope I am right in saying that. What are you doing to shift the current unsatisfactory system, as I think you see it, toward this more ideal one?

(*Professor Proudfoot*) My Lord Chairman, I agree with your first point that in fact this is the ideal and reality is quite far from it. I think it goes back to a point that has just been made about research directors, shall we say, within the universities who are heading up teams. I would have argued that it is part of their role to try and produce these kinds of conditions. Perhaps they are not always able to do it in the short-term but in the long-term this is the kind of goal that they should be aiming at.

Chairman

823. We have something from the University of Edinburgh referring also to the scheme at University College London and it is obvious that both of them as large institutions with hundreds of these researchers are working hard to try and manage the human resource better. I expect when we see the University of Edinburgh we will learn more about it. What are the obstacles towards everybody going in that direction, to answer Lord Howie's question?

(*Professor Lane*) I think traditionally it is to do with the growth of short-term contracts of research, the three-year contracts of research from the Medical Research Council and from the charities. That area grew quite rapidly without thinking, I think, enough about what would happen to the careers of these people. I must say that in the last two or three years this issue has become a central issue and a great deal of thought has been put into it. The Cancer Research campaign, the Wellcome Trust and the Medical Research Council now have an evolving policy on these issues to try and help manage the careers of these individuals.

Lord Howie of Troon

824. It seems to me you are talking about people trying to manage a system which in your paragraph you implicitly accept as being an inadequate system.

(*Professor Lane*) When I say managing the system, I think they are altering the system; that is, they are changing their balance of funding.

825. Does it not all boil down to resource? My Lord Chairman said earlier on that you could not expect an increased resource in the near future, which is probably true. What are you doing to see that this resource is actually increased? You are trying to square the circle of not enough money. That is what it is all about. Most of the career structures and the pyramid we have been hearing about are phantom. You are trying to do your job with less money than you need. What are you doing to try and get enough money?

(*Professor Proudfoot*) I presume, my Lord Chairman, we are trying to persuade influential bodies like yourselves—

Chairman

826. I hope you are not trying to persuade us. I hope you are trying to educate us and give us information. We have not got to the stage of drawing conclusions yet so you may say anything you wish.

(*Professor Proudfoot*) I think the argument would be that we are generally trying to persuade the public of the value of the university, of the activities that they are engaged in and trying to persuade government in general terms again of this so as to try and increase the amount that is made available.

Lord Howie of Troon

827. Fundamentally you do not believe you have got enough money to do your job and you are trying your best fighting against the collar. Is that not the situation?

(*Professor Proudfoot*) Yes.

Lord Howie of Troon: I think that is the whole of our report!

Chairman

828. Given that there is a constant pot of gold, as it were, and given that you have extolled the virtues, and I think we see them, of longer-term appointments, that inevitably means a smaller number of new appointments annually and that in turn means disappointment for those who are graduating either at first or second degree level and there will be a smaller fraction of them who can go on in this way. That, you could argue, would mean that there is a smaller research trained group of people to draw on for the future when the time comes and universities themselves can expand in other ways. You have really a kind of awful dilemma. Your position is favourable and yet you perceive it as bad. I hope I have got the picture correctly.

(*Professor Lane*) Yes, I think that is right.

829. What is the problem? Is it the problem that we were coming back to before, that you have, by and large, a discontented community of researchers right across the board—I am not choosing biomedical topics for the moment—and that this has a discouraging effect on new entrants? If that were the

[Chairman *contd.*]

case and you wanted long-term appointments, then that could be regarded as a good thing in a sense, a natural filter. Is it that the general effect of the perception of science by young people is discouraging generally and might feed further back even into the schools and you would lose the ability that way? Is it that the community in the science area has not quite realised that with some of those who are going to have some research training their future has to lie elsewhere and they have to be helped to be managed to make decisions for themselves which will carry them into rewarding occupations which may lie outside research? It is less so in the biomedical field than in the physical sciences and engineering. Is that broadly the situation?

(*Professor Lane*) Yes.

(*Professor Proudfoot*) My Lord Chairman, I think there are a variety of problems here. I think the shortage of career opportunities in research and in the university generally does deter some very good students immediately after graduating from carrying on and doing research, so they are lost to the research community at that stage. Some of those students who do go on and do a PhD will go into industry or commerce, etc at that stage. It seems to me that there are very strong arguments for getting good research people into industry at that stage. You could argue that one of the difficulties is not just that there are shortages of employment, if you like, at universities, but there is also a great shortage of research generally in British industry and, in fact, if industrial research expanded then some of these problems might well be solved at least in the short-term.

830. Could I just interrupt at that point? One of the striking features also has been the vastly increased amount of money from industry coming to the universities. Is it because they found it cheaper to do it that way?

(*Professor Proudfoot*) I suspect the answer is yes. There is some prestige to be obtained from giving money to universities. There is no necessarily long-term commitment that industries might feel they had if they engaged in the research themselves. It is cheaper for them to get the results through funding the universities than it would be for them to start from scratch themselves. Whether that would necessarily be true in the long-term I think is a very difficult and different question.

831. Well, indeed. Funding bodies and government are likely to notice this and say that industrial research is done on the back of taxpayers' money, will they not?

(*Professor Proudfoot*) Yes.

Chairman: In fact, I think it has happened.

Lord Phillips of Ellesmere: Is not this a part, my Lord Chairman, of a common popular industrial philosophy which is that it is much better if you can to out-source the work, that is to say, not to maintain your own research groups, your own engineering divisions, even your own marketing departments, if you can get somebody else to tender to do it for you and then you choose the lowest bidder? That is a very recognisable phenomenon in an industry which my colleagues, I am sure, know more about.

Lord Howie of Troon: That is when you go bust, is it not?

Chairman: When the lowest bidder goes bust, yes.

Lord Haskel

832. Would you not agree that one of the reasons why a lot more money is coming from industry is because a lot more firms find the need for research and the only way that they can become involved and get this research done is by sub-contracting it out? It takes years to set up a research laboratory, hire the staff, train them, get the whole thing set up. By the time that is done, if you had gone to a university you would have the work done. Would you not agree that that is the main reason?

(*Professor Proudfoot*) It is one of the reasons. If you go back to the 1960s and look at the establishment of the new universities then, some of them established very worthwhile research laboratories inside a year or two and with not very large expenditures of public money at that stage.

Chairman

833. Perhaps another feature is that those new universities are trying, because of the windfalls which you get if you can get research ratings under the funding formulae of the Scottish as well as the English Funding Council, to establish research groups themselves. Do you regard this as a wise thing to do or do you think that research support should be more selective and distributed through the universities? Perhaps you do not agree with what I have said about the pressure of the funding formulae to drive universities to do research.

(*Professor Proudfoot*) I agree with the preference to achieve high ratings and, therefore, to attract additional research funding.

834. It is an awful thing to have to face in a sense. You have to say there is a limited amount of money for research. You have a choice between, on the other hand, equitable distribution, which is quite ineffective, or concentration, leaving some people out in the cold.

(*Professor Proudfoot*) I think it is partly going to depend on the subject area and the kind of research that one is carrying on. For some very expensive research it is inevitable that it is going to be highly centralised.

835. But physical methods have become so universally needed in all relative research now it is very difficult to get away from expensive equipment, is it not?

(*Professor Proudfoot*) Yes. We have elsewhere argued that people who are teaching within the university system ought to have access to research facilities, not necessarily in their own institutions, and there ought to be ways in which they can in fact do this so that would cut across some of the problems at least.

836. This goes back to something I remember from when I convened a conference at Nottingham in 1967 on the co-operation of universities. It is true, is it not?

[Chairman *contd.*]

(*Professor Proudfoot*) Yes. There have got to be facilities for people to move to where the research equipment, etc is. There have got to be incentives both for the individuals and for the institutions, both the institution to which the person belongs and the institution to which the equipment belongs, to get suitable recognition of these.

837. I remember there used to be arrangements for this in Scotland. There was a joint Scottish business school, there was a joint Scottish nuclear reactor centre and so on and so forth. They have fallen apart.

(*Professor Proudfoot*) The reactor centre still exists.

838. But it is not used much now, I understand.

(*Professor Wilkinson*) It has changed its direction more towards archaeological purposes.[1]

839. That is really a narrow field, is it not? Have you got other examples that could help you in Scotland in this way?

(*Professor Lane*) Yes, my Lord Chairman. There is in protein chemistry in Aberdeen University.

840. Combining with?

(*Professor Lane*) It is accessible to all Scottish universities.

841. The facilities they have?

(*Professor Lane*) Yes. And, also, in Stirling University there are some common facilities as well.

(*Professor Proudfoot*) There are also joint MSc degrees in laser engineering and often electronics between Heriot Watt and St Andrews, for example.

Lord Phillips of Ellesmere

842. My Lord Chairman, does that not take us back to the influence of the funding council where, of course, the Scottish Funding Council operates somewhat differently to the English Funding Council? Would you agree with me that the research assessment exercise and the associated funding that flows from that exerts pressure on universities to do a great deal of research and in order to do that they need graduate students and post-doctoral students to produce, if you like, first of all, the volume of research which is to be assessed and, secondly, the volume of people who are included in the funding formulae that decide how much money you get? Do you see this combination of the research assessment exercise and funding formulae as having a desirable or undesirable effect on the way in which research is evolving in universities?

(*Professor Lane*) It certainly encourages intense competition between universities which in a way can act against these more co-operative and collaborative agreements because departments in a very real sense are competing for a fixed pot of gold and I think some of the rather aggressive recruiting schemes that one has seen in universities is a direct consequence of the desire to hire in people with good publication records in time for the next exercise. Particularly in Scotland it is noticeable where the total pot is quite small. If you in your department do very well you do so presumably at the cost of the amount that can be allocated to your compatriot departments who arguably you ought to be working with. I think there is a problem created there.

Lord Redesdale

843. Going back to the Wellcome Foundation, when we took evidence from them I was actually surprised at the very limited number of people they actually fund. Because these people are quite expensive, if you were actually producing a piece of work would you find it more efficient to get a larger number of short-term contract people in or would you think about the long-term implications? I very much suspect that with most universities, whatever they say about good guidance, there is a very strong temptation adjusting for the cost analysis of it and hiring a very large number of people, especially if you have got one piece of work.

(*Professor Lane*) It does depend a lot on how the exercise assessment is carried out. One of the difficulties of the universities is now to balance that against all the other pressures. For example, will only SHEFC-funded members of staff be counted in the assessment exercise? What rating will a post-doc or PhD student obtain in this exercise? How many members of your staff should you put forward? Should you put forward the whole department with a poorer average or should you select carefully your stars and only put them forward? Those questions are very serious because real income is at stake here and they have caused much consternation, I think, in universities. It is a difficult question to deal with. It absorbs a lot of time and effort and the rules are often not made clear to us. In trying to plan ahead it is difficult. This planning involves whether you are going to make an appointment. Whether a department can afford to appoint a new lecturer depends on its perceived financial position which is directly related to how it is going to score in such an exercise.

Chairman

844. And if you add to this the complication of cooperation with another university, how you share out the money.

(*Professor Lane*) Yes, that is right, or, indeed, cooperation within departments in universities.

845. Do you recommend that we should put these questions to COSHEP who we shall see?

(*Professor Lane*) I think you should, yes.

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[1] The Scottish Universities Research and Reactor Centre combines teaching and research facilities in isotopic, applied nuclear, earth and environmental sciences. It receives core funding from the Universities of Glasgow and Strathclyde, as well as roughly equal income from research grants and contracts. The Universities of Aberdeen and St Andrews are associate members, having specific access to the isotope geosciences unit at the Centre. The Centre also hosts the NERC Radio Carbon Dating Laboratory, some of this Laboratory's research being concerned with archaeological dating.

Lord Redesdale

846. Would it be seen as a shortcut to hire short-term contract people? Would that be seen as the easiest option?

(*Professor Lane*) A lot of the research assessment exercise will depend upon productivity factors and ratings of excellence. Hiring short-term staff is a way that you can increase your productivity per staff member. There is a drive in that direction. As I have indicated, it does so critically depend on how these sums are done.

Chairman

847. What is the measure of productivity?

(*Professor Lane*) My understanding is that it is to do with the number of publications as a key indicator from the department and research income.

(*Professor Wilkinson*) We really do not know because they have said so far that weighing the amounts of paper will not happen this time. They are going to judge quality on the four best papers over the last four years submitted by each person. Whether the actual subject committees when they sit down in their little huddles and judge, they will stick to this, is difficult to know. We know that last time what happened was very different from discipline to discipline, from the written accounts of various Chairmen of the Committees. While one picks the best four, you watch over your shoulder very carefully just in case somebody does start weighing paper again.

Lord Haskel

848. How much management time is spent in trying to second-guess all of these things that you have been describing to us which could usefully be spent on doing some research?

(*Professor Lane*) An awful lot.

Chairman

849. Let me put it another way. You are all old enough, I think, to have experienced the old system in which there were subject committees of the Universities Grants Committee who visited you for one or sometimes two days, depending on the size of the group, and you sat across the table, as we are doing now. Looking at it dispassionately in the light of your experience, which do you think is the better system, that one or the one you have got now? The former was not in any sense transparent. It was an engagement of people talking about the common work and teaching and research. The present one aims to be in the words of the funding councils more "transparent" and the formula is there. There was no formula before. It was impressionistic. What do you think is the more just of those two systems and nearer to the truth?

(*Professor Lane*) I will give you my own view first. It may not be that of my colleagues. I think the present system is extremely difficult because it really has that system behind it and yet it has built up these rather superficial indicators and we are not told in detail how these indicators will be interpreted. A lot of time is spent, as you say, trying to second-guess what is going on. Specific examples: if you have a wonderful paper but you have done it with your colleagues in America or industry, is that the right paper to cite because how is that going to be rated? We do not know. It might be better to cite your less good paper which you wrote with one of your university colleagues in your department. That is a bizarre decision to have to make.

850. Why do you not ask the funding councils this? Has anybody tried?

(*Professor Wilkinson*) Yes. We fear that we will be told two weeks before when it is all too late and the paper is in. The committees have not yet decided what they are going to do in detail.

851. Again, in the old days the subject committee also carried with it a representative of the relevant research council who therefore had his fingers to some degree on the pulse of what was going on in that research council in that particular field. Do you know whether the funding councils have any such input?

(*Professor Proudfoot*) No, not as such.

852. You are saying they do not have it?

(*Professor Proudfoot*) Yes.

Lord Howie of Troon: From your memorandum and from this conversation I do not get the impression that you are terribly enthusiastic about the current arrangements. Should the Scottish universities and others move away from the current system towards the longer-term employment situation which exists in industry and public sector research establishments?

Chairman

853. The question is should you?

(*Professor Lane*) My answer is that we should, but in many ways it is not possible for us to do that. Many of these contracts are coming from people who are buying our services, if you like.

Lord Howie of Troon

854. But suppose the contracts were not direct to the people who were doing the work but were to, say, the university or the university department or something of that sort and the funding was then attributed within the university to long-term people; you would be quite happy with that, would you not, if you could actually get it to work?

(*Professor Lane*) If you could get a system where somebody gave you the pot of money and said, "Carry out this research in a responsible way," then you could control the situation and you could carry it forward. At the moment we are micro managed. We are told that we can appoint a post-doc at such-and-such a grade. There is this age scale, which I am sure you have had discussed with you before, which means that you discriminate against your very experienced people because they are more expensive. I would rather have a system where somebody says, "Here you are, Professor Lane, you have done good research on this topic for so many years. You have submitted an application of what you wish to continue. Here is the money, you do it." If that means

[Lord Howie of Troon *contd.*]

you buy something from here and you fund your team---

855. To a very large extent the control of your general research culture is out of your hands?
(*Professor Lane*) Yes.

856. And you would rather it was more in your hands than out?
(*Professor Lane*) Yes.

Lord Phillips of Ellesmere

857. If I may, my Lord Chairman, attempt to unpick that a little further. The research councils and the Wellcome Trusts and other bodies do provide longer-term support in MRC units which have been mentioned and in programme grants and so on of this kind. Are you saying you would like to see more of that?
(*Professor Lane*) Yes. My own grant is on a five-year rotation. I find within that it is easier to manage these difficulties because many people have a five-year contract and if I am trying to say to them, "I do not think this is ultimately the right career for you", then I have got time to guide them into something else which I would not have on a three-year contract.

Chairman

858. We have gone over a lot of aspects of these problems already and we also know that the research councils and the Committee of Vice Chancellors and Principals in England (I do not know what is happening in Scotland; we shall discover this tomorrow) have been trying to work out a system for the management of these things and yet we also need to have the research councils in this, which applies to both countries. Are we not really working towards the fact that these groups of people are too far apart from one another, need to co-operate and need to provide continuity at the top level? Even so, you are still left with a problem at the departmental level and now departments are cost centres. As I understand it, if you are a relatively small department but with some research then it is very difficult to have bridging funds to keep on a good man for a period, it is very difficult to be able to advise him that he is good, that you might have in five years time a post which you could offer to him and he will have priority, which is an essential of the University College London scheme, and even more difficult for you to keep the person by advertising for a five year Warwick research fellowship. Are the universities to blame as well as these outside agencies?
(*Professor Wilkinson*) I am not sure how the universities vary in what they are doing, but I think in general terms most of the universities are moving towards the amalgamation of cost centres into larger units. Certainly at Glasgow we have the Faculty of Engineering as one cost unit. Therefore, from the point of view of just this kind of thing we do have the resource to tide somebody over for a few months. We have recently said to somebody that he will be given a lectureship in five years time when the EPSRC scholarship comes to an end.

859. How is this done in financial terms? Is it that the money accrues to a general faculty?
(*Professor Wilkinson*) It is complicated. An amount of the fee income comes into the faculty. A percentage of the research income from the funding council comes into the faculty. Most of the overhead from the research councils comes into the faculty. More than the fees comes back from the foreign students and so on. It is a very complicated thing, but a faculty can finish up with a nest egg, to use at its discretion.

860. That can be distributed irrespective of the source of the income within the faculty?
(*Professor Wilkinson*) Yes.

861. So if you have a big faculty you could manage to do some of these things?
(*Professor Wilkinson*) Yes.
(*Professor Proudfoot*) I think virtually all of the universities have moved towards faculties or schools which do have more flexibility. There is, of course, the other problem with the universities in that you have got to balance the demands of teaching against the demands of research and these two may not be congruent as a consequence.

862. The sum which is communicated to you by the funding council, is that in any way subdivided or does it come as a global sum and you know that it is being worked out by a formula which you have most recently criticised?
(*Professor Proudfoot*) In the case of the Scottish universities the money comes from the funding council to the individual universities. There is virtually none of it earmarked and the funding council is relatively transparent as to how it has arrived at its funds.

863. When it comes into the university, does the university have regard to the way in which it is being calculated for its own university when it distributes that money? In other words, is the university just a channel for the decisions of the funding council and ceases to be a free agent with the block grant?
(*Professor Proudfoot*) I would not dare speak, my Lord Chairman, for each of the universities.

Lord Phillips of Ellesmere

864. The university does know how much comes as a Research related amount.
(*Professor Wilkinson*) A great deal of discussion is concerned with this. The first time round the Scottish Higher Education Funding Council used a formula for determining the unit of research which it said it did not like. The Universities were permitted to vary internally the allocation, and in the case of the University of Glasgow, an internal unit of resource was devised. This time the Scottish Funding Council had a much more sensible use of resource and that was very close to one which we had been moving in our university towards, so the two are now almost the same. There is always the issue of how much out of that research money goes back to the centre for new initiatives because clearly the centre would like and should have some money to start up new research.

Chairman

865. In principle, with a large university like Glasgow or Edinburgh it should be possible, whatever you may think about its origins, to manage this group of contract researchers in a more humane and perceptive way than at present.

(*Professor Wilkinson*) No. It is not the funding council's problem, it is the research council's. If you are not on the academically related staff you cannot apply for a research grant. I checked this late yesterday with the EPSRC to see if they are about to change their rules and they are not. This means that a temporary person cannot apply for a research grant, so the post-doc cannot apply for a research grant.

866. He has to have a sponsor within the department who is?

(*Professor Wilkinson*) The academic member of staff who can apply for research funds is limited in whom can be supported with these funds. It is not possible to pay either full time academic or academically related salaries from Research Council funds.

867. What obstacle is there towards a member of staff making an application to a research council for a grant?

(*Professor Wilkinson*) He may not receive any of those funds himself.

Lord Phillips of Ellesmere

868. Must not we distinguish between the academic staff who are funding council funded, so to speak, and the other staff, most of these contract research workers, who are funded by research council funding streams or charities or whatever? I do not understand the difficulty you are having with the academic staff who are funding council supported.

(*Professor Wilkinson*) We have five academically related members of staff out of 45.

Chairman

869. You mean they are cross-related people who hold purely teaching appointments?

(*Professor Wilkinson*) No, they are academically related.

Lord Howie of Troon

870. What does "academically related" mean?

(*Professor Wilkinson*) They are not teachers but on the same scale.

Lord Phillips of Ellesmere

871. They are funded by?

(*Professor Wilkinson*) They are funded by the university. We call them research technologists which explains what they do. They look after extremely advanced pieces of equipment and are the core behind the work. They cannot be funded from the research councils. You can put in the costs of technicians but you cannot put in the costs of research technologists on the grants. If you could then we would probably extend that stream to include people who were less technological and more research orientated. That would be extremely helpful.

Chairman

872. The research councils do not pretend that some of the research can be done without these people being employed.

(*Professor Wilkinson*) No.

873. So why do not they accept some of the responsibility for it?

(*Professor Wilkinson*) I do not know. It has grown up and they are very adamant about not doing. Another reason is that the number of research technologists varies greatly from university to university and obviously it tends to be high in high technology areas. In our case we maintain electron beams machines which cost £2 million each. For that you need somebody permanently working at them. There are other departments who do not do that sort of thing.

Lord Howie of Troon

874. I wonder if you could explain something to me. You are inhibited by certain rules, obviously. Whose rules are they?

(*Professor Wilkinson*) The EPSRC's. I do not think it is the Treasury this time!

Lord Howie of Troon: Don't you believe it!

Lord Haskel

875. Who lays down the difference between a research technologist and a technician? It seems to me it is a very fine differential.

(*Professor Wilkinson*) Typically a research technologist has a PhD usually.

Chairman

876. It is the difference between a man who can develop it at a high degree level scientifically from one who will maintain it and make systematic improvements but not breakthrough ones. Is that right?

(*Professor Wilkinson*) It is right, although it has led to a difficulty particularly in biological sciences. Technicians often start with degrees, have got a PhD in the university, have come to the top of the technician grade and then the universities have been very reluctant to appoint them on to academic related posts because it would cut down on the number of teaching staff that there are.

877. Would you agree that there are difficulties in the funding of some of the contract research staff and that those difficulties arise from conditions which are imposed and associated with grants by the research councils, amongst which are those which preclude academically related staff from, in fact, having the ability to apply to research councils and also to be paid by research councils?

[Chairman *contd.*]

(*Professor Proudfoot*) No, to be paid by research councils. The difficulties arise from temporary staff being forbidden from applying.

878. Yes, indeed, that is what I was saying. Also, would you therefore draw the conclusion that it is necessary for the universities and the research councils, preferably also with those who fund the universities, to get together and to iron out some of these difficulties so that the obstacles for the sensible management of the money, whatever its source, is to the benefit of the work that is to be done and of help to the university and the career aspects of the university's individuals? Within that it does mean that a number of those people will have to go.

(*Professor Proudfoot*) Yes. I think we would all agree with that.

879. If we all agree on it it is probably of little significance! Warwick University is a case which has taken the bull by the horns and said somehow or other—and this is not a very big university, though it is big enough—"We are going to establish 50 six year research fellowships." Do you think that is a sensible thing to do and can you hazard a guess as to where they get their money from to do it?

(*Professor Proudfoot*) I think Warwick is a particular situation and this may or may not be a sensible solution for them. I am not sure how practicable it would be everywhere. There are obviously advantages in giving stability to the individual and to the institution in as much as they can plan on the long-term. One of the obvious disadvantages is it solves the problem immediately but it does not solve it in the medium term because, in fact, although some people have four, five, six years of research contracts and then automatically teaching contracts, thereafter it is in fact narrowing the opportunities overall in four, five, six years time depending on the timescale involved.

880. There is a difference, is there not, namely that Warwick was founded in 1963 and therefore it had a bulge and in five years time it will be 40 years older, roughly, and that means they will be retiring?

(*Professor Wilkinson*) Yes. This might suit Warwick but it would not necessarily suit other institutions because of the particular age structure of their staff.

881. I understand that the University of Leeds, which is of course larger, is doing much the same thing.

(*Professor Wilkinson*) I am not sure that any of us know how these are being funded. This goes back to the whole problem of the university funding in as much as it has always been seen to be effectively funding for teaching and, therefore, universities have been reluctant to devote some of their funding to research.

Lord Phillips of Ellesmere

882. Has there not been a very significant change in that we can all look back on the days, or most of us, when the universities used to have a large block grant from the UGC which was readjusted quinquennially and could be relied on for five-year periods and that was a major source of funding supplemented by research council support and so on? We now have that subdivided into fee income as well as block grant income, the block grant adjusted every three years on the basis of the research assessment exercise that we have been talking about. It is smaller perhaps in terms of student numbers but at the same time there are new funding streams. There is much more industrial support than there was. There is actually much more research council support than there was. Universities in the 1990s have to be used to managing multiple funding streams rather than, in effect, a single funding stream. Whether or not they can do the sort of thing that Warwick or Leeds are doing depends very much on their skill in managing these multiple funding streams. Is that not right?

(*Professor Proudfoot*) Yes. One assumes that the money is coming from a variety of sources and they estimate that they are going to be able to draw on these sources over the decade.

Chairman

883. That is just like running a business, is it not?

(*Professor Lane*) One of the difficulties that has faced us is the very short timescale in which major changes are introduced into these faculties. I would particularly emphasise from Dundee University's point of view the very rapid loss of the overhead element that was associated with charity research income in the biomedical area; so the Cancer Research Campaign and Wellcome Trust grants now carry no overhead of the type that they used to carry whereas ones from the Medical Research Council do. It has a huge impact on the universities. In terms of forward planning it is very difficult to cope with in our particular set of circumstances.

884. The Association of Medical Research Charities are well aware of this problem but they too have problems because of the basis upon which the money was raised, which was on the assumption that the universities would be well founded.

(*Professor Lane*) Yes.

885. I wonder if we could go on and in a sense this comes back to the point that Lord Phillips and others have been talking about which is that there is an increased and difficult responsibility to be discharged by the universities now to manage this particular group of people and they have somehow to be brought into a position where they can do this. The smaller the university or the lower its research income, the more difficult it is to manage this because the fluctuations as a percentage of the sum available that you need in order to smooth it out is larger the smaller the unit, so this brings us back again to the problems of policy making at the top. The research will have to be, it seems do me—perhaps you could correct me here—such that it is almost inevitable that you will be faced with a situation of research being more concentrated in universities. That may mean co-operation if we are not to lose the new blood which comes from those that are not major centres and that very cooperation itself, by what you have told us before, leads to difficulties if in fact in the main funding councils' estimates of research are conducted on a basis which does not only not carry

[Chairman *contd.*]

your complete conviction but is not completely transparent. Is that fair?

(*Professor Lane*) And urges and emphasises competition where sometimes you need co-operation.

886. It is essential in your view, is it, that the universities, the research councils and the funding councils get their act together?

(*Professor Lane*) Yes, I think that is right.

887. Perhaps we may go on to the question of industry. There have been a lot of comments about this. We heard a number of comments about the interface between the universities and industry not being as good as it should be. Some of us who went to the States discovered some rather imaginative schemes there for joint activities. What is your assessment of the position at the moment about this in Scotland?

(*Professor Wilkinson*) Again it very much depends on the sector. The Scottish electronics sector is mainly multi-national, they mainly do their research back home and therefore the amount that they require locally is not enormous. That means that in an electronics Department we need to see our research on the European and global scene, reflecting the needs of industry which takes a global view. One of the things that certainly has changed in the last two years is the ending of LINK. The LINK schemes were working very well. They brought different companies together.

888. Could you explain for the record how it worked as seen by you?

(*Professor Wilkinson*) There had to be a proposal to undertake some research which was industrially required. There had to be two industrial companies to begin with and one or more university. The universities were funded by the SDRC. The DTI paid up to half the cost of the industrial partners. There are complications in that which I will not go into. The schemes normally run for three years. The typical type of funding was between £½ million and £1½ million over that period. There would be co-operation, there would be joint meetings at least every six months, often every three months, and the programme of work would have been divided out among the various parties and then it was progressed with meetings and with workshops and so on. The advantage of it was that the industrialists came to the universities, the academic got into the industrialists' premises and the mutual problems were seen and understood. It led to an awful lot of continuing work between our universities and industry which was not LINK funded.

889. So there was a big spin-off?

(*Professor Wilkinson*) Yes. There is still a great deal more to be done. LINK had started penetrating into the chemical industries and the mechanical industries where you might say science has been less prominent.

890. Did you say the chemical industry?

(*Professor Wilkinson*) No, bits of the chemical industry. Things like ink and all sorts of peculiar things, ceramics. Not the high-tech ceramics but the lower tech ceramics. The arguments for killing it are very difficult to discern. The outside rating of the LINK schemes had been good.

891. Were any official reasons given by the DTI?

(*Professor Wilkinson*) I think they felt that it did not need to continue and that it was more effective to work directly at the level of setting up consultancies who would transfer information directly from the universities to the industry.

Lord Phillips of Ellesmere

892. You will recall, my Lord Chairman, that when the Committee met the Chancellor of the Duchy of Lancaster and the Chief Scientific Advisers some weeks ago, we were informed that LINK was considered a success, that it needed to be reviewed, but it was being re-launched rather than killed.

(*Professor Wilkinson*) At the end of 1994, it was clear that long-term funding of LINK schemes by the DTI was to be cut drastically. The long-term prospect was that funding would drop to a third of its level at that time. There is not even enough money to keep the monitoring committees for programmes which have committed their money to continue.

Chairman

893. Is this the re-launch scheme funds which are down by one-third?

(*Professor Wilkinson*) In the absence of new programmes being introduced by DTI, the level of funding for LINK by DTI will be down one third in a few years time.

894. Is this the re-launch scheme or is it the rundown of the old scheme?

(*Professor Wilkinson*) At the re-launch, a new £6 million was promised; £3 million from the Research Councils. It is by no means that this will continue. The scheme at its present level is a DTI commitment of £30 million a year.

Chairman: Clearly we must try and find that out.

Lord Haskel

895. My understanding about the running down of the LINK scheme is that the view of the DTI was that it was meant to be a pump-priming scheme and it set things going and then they would leave the industry and the universities to get on with it.

(*Professor Wilkinson*) The LINK schemes have uncovered large areas in which academic and industrial collaborative research was needed. The schemes was working well. I agree with the move inside LINK towards the involvement of smaller companies and away from larger ones.

Chairman

896. You referred to the smaller companies, the SMEs. Is it also your experience that it is the SMEs who most need the co-operation with universities? You mentioned ink, for example, but is it also the case that a higher proportion of them do not know that they need it?

[Chairman *contd.*]

(*Professor Wilkinson*) I think they know that they need it.

897. Who cannot afford it?

(*Professor Wilkinson*) Whether they can afford it or whether they can even afford the time that it takes to get it. One of the problems was that LINK did take about a year to get the money and that is a very long time for a small company.

898. You mean the DTI was slow in paying the small company?

(*Professor Wilkinson*) No, the time it took to make sure you were going to get one from the first idea through to the realisation.

899. Why did that adversely affect the companies?

(*Professor Wilkinson*) Because you have decided to put away some resource in that direction.

900. The company?

(*Professor Wilkinson*) If you are a little company it is an awful long time to plan forward.

901. So it is money locked up for a long period?

(*Professor Wilkinson*) Yes.

902. Is there anything you want to say under the heading of your experience with industry? Yours, of course, is biomedical and you are in a fortunate position in that you have got an industry behind you of some magnitude which also solves the problem of the clinically qualified people because they have a fall-back position.

(*Professor Lane*) Yes. It is possible to collaborate with the pharmaceutical industry and obtain support in our area. I must say that the intellectual property right questions have become increasingly difficult for everybody and that is, I think, still a question very much up in the air as to how that is going to proceed.

903. That is not our responsibility at the moment. Professor Proudfoot, have you anything you want to say on this subject?

(*Professor Proudfoot*) I do not think anything additional to the comments we have made before.

904. On the question of women in science; we have noted all that you have said about that and it seems to be very common to what other people have said. I think universities are progressively taking steps forward here in the right direction and it is going to be a matter of time before the ideal arrangement, if there ever is one, is going to be firmly established. If you are a small institution it is less easy to get a good return from policy than it is if you are a large one. I do not know whether there is anything you want to add to that?

(*Professor Proudfoot*) No, I do not think so.

(*Professor Lane*) I read the MRC evidence to you on this point and it seems to concur very closely with what we thought.

905. May I just ask you the final point which we must touch upon and that is in the Research Masters pilot degree because I noticed with great interest that the Royal Society of Edinburgh in its annual report said that it endorsed the one plus three arrangement, whereas the evidence from the University of Edinburgh and from other sources appears to go against that.

(*Professor Proudfoot*) We did say at one stage that we were in favour of this one plus three in some situations. We have stressed the very considerable difference in background to students coming in to do research. There are some disciplines, shall we say, like chemistry where you proceed with very straightforward planning. On the other hand, there are areas like geo-physics where you might come in as a geologist with very little physics or a physicist with very little geological background. That is a very different kind of research student from the one who is carrying on in his or her original discipline.

906. Presumably you have always had this problem and you have always had to do some re-education and retraining, have you not, within the three years? Why did you add an extra year on as being desirable, bearing in mind that with a fixed pot of gold that meant, whatever it is, 25 per cent or 33 per cent fewer entrants if it were applied to everybody?

(*Professor Proudfoot*) Again going back to the ideal situation, we would hope that one would not reduce the pot of gold. In the real world then I think there are circumstances where a four year PhD is almost inevitable.

907. May I take it that the Royal Society of Edinburgh was really saying that it is necessary in some areas but it was not giving general endorsement to the policies across the board?

(*Professor Proudfoot*) I would think that is true, yes. We have so far got no MRes degrees in Scotland at the moment.

908. There is a pilot scheme, of course, on offer and universities have made bids. Have any universities in Scotland, to your knowledge, been selected?

(*Professor Proudfoot*) No.

(*Professor Wilkinson*) We would like to know why we were not selected.

909. I know the results are out because I heard from one university only three days ago. None in Scotland?

(*Professor Wilkinson*) No.

910. Perhaps we had better leave the question at that point.

(*Professor Proudfoot*) Or pursue it in another place!

911. Thank you very much for all you have told us. Before we finish, are there matters which we failed to touch on which are not in your report which you would like to bring to our attention?

(*Professor Proudfoot*) I think we have probably covered all the points that we can certainly think of at the moment.

(*Professor Wilkinson*) There is one point I would like to mention and that is women in science. I think it cannot be said too often that it all starts at the primary school level and it is there that the concentration has got to be made. The reason why we have not got so many is that they do not take the A levels. The determining factor is very early.

912. That is one of the determining factors, but we have also been told on good evidence from ladies deeply concerned about this that the girls in single sex secondary schools at any rate choose more

[Chairman *contd.*]

frequently science than those in the mixed schools. Is that not a factor?

(*Professor Wilkinson*) That is perfectly true. Would you therefore recommend that you divide out all schools into single sex schools again? Whether the disadvantages of that out-weigh the advantages for science I think are very debatable.

913. There is one social factor there.

(*Professor Wilkinson*) There certainly is.

914. That we have got to overcome. You are presenting to us teaching and that science does not come early enough and is not sufficiently well presented. Is that right?

(*Professor Wilkinson*) It is how it is presented even at that age. What is being argued, I think, by saying the single sex schools are better in science is that the boys cannot dominate and push the girls out of the way. If the girls have got the self-confidence from the primary school where both sexes tend to play together much more and they can do this kind of thing, then they are not put off in the same way in the secondary school. That is why I was arguing that.

Lord Phillips of Ellesmere

915. My Lord Chairman, surely it is again, to some extent, a sectorial problem. The number of female undergraduates in courses like biology and medicine is at least the same as the number of male undergraduates in courses of this sort and the numbers in chemistry I think have also gone up.

(*Professor Wilkinson*) It is increasing.

Chairman

916. And in engineering too?

(*Professor Wilkinson*) Not in engineering.

Chairman: South of the border it is.

Lord Howie of Troon

917. There must be more than the one that was there when I was there.

(*Professor Lane*) In the biomedical area you go through to the PhD level with roughly equal numbers and post-doc level with equal numbers and it is after that that you hit the problem. It is terribly clear in the MRC's evidence that there are very few women professors at all and particularly in biomedical areas it is still the case. Whether that is just going to be a time thing, I do not know. I think a certain factor of it will be. It is feeding through. There is probably some barrier there as well. We will have to see what happens in the next ten years.

Chairman

918. To return to Professor Wilkinson's point; the national figures are that more women are coming through in engineering at the first degree level but not in large enough numbers.

(*Professor Wilkinson*) No.

919. May we thank you very much for coming. Thank you for allowing us to use your premises for this purpose.

(*Professor Proudfoot*) We are delighted to have you with us.

WEDNESDAY 26 APRIL 1995

Present:

Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Haskel, L.	Redesdale, L.
Howie of Troon, L.	

Memorandum by the University of Edinburgh

This document consists of the response of the University of Edinburgh to the specific questions asked by the Sub-Committee, together with two Annexes (*not printed*) for the Sub-Committee's information. Annex I is the text of a 1994 internal report on the position of short-term contract research staff in the University; Annex II is the response of the University to the Office of Science and Technology enquiries in 1994 about the MRes degree proposals.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

The problems for the scientists themselves are that while posts at a junior level, immediately postdoctoral, are comparatively abundant the vast majority are on short, fixed-term contracts. There are few senior posts, and the senior posts frequently have much less security than hitherto. The advantages are to the employing organisations which are able to select the most successful of the many strongly competitive research scientists.

2. *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

There are advantages to the employing institutions, which are able to launch into areas of research without long-term commitment to staff or resources. There are disadvantages to the scientists concerned, who are unable to make long-term plans, have difficulty with matters such as house purchase and in settling into family life.

There is a disadvantage to the process of research itself in that scientists are unwilling to make commitments to long-term projects, are distracted by the search for new employment opportunities and frequently move to another short-term funded post before their current contract expires. They may thus be unable to acquire some skills in research techniques which may take time to be mastered. Conversely, the skills that short-term research staff do acquire are very often immediately lost to the institution that made an investment in the training of such staff, as they move to other employment.

Finally, there are potentially harmful effects on the quality of research itself. With the changing proportions of short-term (usually rather junior) research staff, there is a tangible shift in the locus of research away from experienced academic staff towards the growing regiment of less-experienced research assistants.

3. *How do you expect the situation to change in the next decade?*

By the end of the decade there may be an upsurge in recruitment in some of the major research universities as present academic staff reach retirement. It is not expected that there will be significant growth in the availability of research-based posts in the university system as a whole. The recent Efficiency Unit Scrutiny Report of the Public Sector Research Establishments seems to suggest a significant future reduction in funds for research activity in this sector which draws its scientific staff from the same pool as the research universities.

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

There is little, if any, systematic data on the subsequent careers of scientists who leave contract research from this university. Anecdotal evidence indicates that significant destinations have been to teaching posts in higher and further education, some to schools, with, in the past, significant numbers moving to the financial sectors. Some have entered journalism or politics, and a few have risen to some height in these areas.

5. *What should be done to improve the mobility of scientists between academia and industry?*

Mobility is good between universities and major companies in areas such as chemicals, petroleum and pharmaceuticals. Staff are willing to move into areas where their scientific careers can achieve recognition, so that they are reassured that they could reverse their move. Companies which permit or encourage their staff to publish and to participate in academic conferences will be more readily able to attract good scientists. Small and medium sized enterprises are frequently believed to show less understanding of the nature of the environment needed to foster scientific excellence.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

There is evidence that recent years have seen a change in the proportions of participation of women in science and engineering. Recent appointments in the science-based sector of this University, at all levels, have included many more women than would have been expected a decade ago. This comparatively recent influx of very able women is steadily working its way through the system. One reason may be that more families regard two incomes as desirable in view of the diminished security of all employment.

There is still a tendency in schools for a degree of gender stereotyping, with females less likely to be following the physical sciences, with more to be found in biological sciences. However, there are now better role models for women scientists and the effect may be to gradually diminish the traditional stereotypes. The chief obstacle to extensive involvement of women in science and engineering nationally remains this stereotypic problem of "culture". The self-confidence and willingness to be relatively assertive that characterises many male scientists participating readily in the competitive arenas of public debate, through publication and conference presentations, seems to be less congenial to many women scientists. Some measure of positive discrimination in the Equal Opportunities policy of institutions may be effective in future in changing this unequal culture. But the first and essential step is for the leadership of an institution to become determined to employ women on their merits. No significant advance seems likely to happen without this commitment.

The publication in February 1994 by the Office of Science and Technology of *The Rising Tide: A Report on Women in Science, Engineering and Technology;* the launch of the *Association for Women in Science and Engineering;* the support given by the Royal Society to new measures to promote women in science, engineering and technology; and the very recent creation of the women's development unit by OST to promote these interests are all likely to be influential in improving the situation of women.

7. *Please outline your assessment of the worth of the MRes degree scheme.*

This University remains somewhat sceptical about the demand for and merits of a stand-alone MRes degree, but we believe that the modules which would constitute such a degree programme could also be beneficial to the general education of PhD students. Another academic benefit might be that the modular structure of such courses may facilitate the growth of an interdisciplinary, problem-solving perspective in the students.

Accordingly, we have made bids to the appropriate research councils under the scheme, have been successful with NERC and are short-listed with proposals to EPSRC and MRC. The development of these schemes will absorb significant resource and it is not yet clear that stand-alone courses of this sort could be financially viable in the long term.

Finally, we believe that the success of the MRes degree, where it is aimed at producing postgraduates valued by industry for the usefulness of their research capability, will only succeed if there is extensive support and involvement in the course from industry itself.

Examination of witnesses

DR FRANCES DOW, Vice-Provost of the Faculty Group: ADM (speaking in her capacity as Convenor of the University Staff Committee) and DR DONALD E S TRUMAN, Vice-Provost of the Faculty Group: Science and Engineering, University of Edinburgh, called in and examined.

Chairman

920. Thank you very much indeed, Dr Dow and Dr Truman, for coming to see us today. You know the subject we are talking about. Do you know why we are interested in it or would you like a little background?

(*Dr Dow*) It would be helpful if you would just sketch in the background very briefly.

921. What we, of course, discovered is that if you look back over the last, say, one and a half decades or so, whilst the number of staff who are in established posts in universities has remained about constant in the United Kingdom system, there has grown from about 5,000-odd to now over 22,000 those people who are living on short-term contracts of two and three years duration in science and technology in particular, and also, of course,

[Chairman *contd.*]

including medicine. We are concerned about these people because not only do they have difficult problems themselves but they are also easily exploited. We also think that there may well be adverse effects on the quality of research which is done under these circumstances and so the Select Committee on Science and Technology set up a sub-committee, which is the normal way of working, to look into this problem just as it has looked into other problems where they feel they have a special contribution to make. That is the background. We have taken a lot of evidence in writing and orally and this is the opportunity for you to give evidence on behalf, as I understand it, of the University of Edinburgh. It might therefore be helpful if you would tell me how you came to be appointed, what you normally do and what your special knowledge is that you can put in front of us. After that you might like to make some general observations, bearing in mind that we have read what you have written. May I also add that through the good offices of Lord Haskel we have also got a paper describing the activities of the careers service in the University of Edinburgh in providing counselling for people in the category which I have described.

(*Dr Dow*) As you know, my name is Dr Frances Dow. I am a historian by training and I am Vice-Provost of the Faculty Group of Arts, Divinity and Music at the University of Edinburgh. I am here today because I am Chair of our University Staff Committee which has responsibility for the development of staffing policy for all staff groups, but particularly academic and related staff, therefore including research staff at the university. As you know from the University of Edinburgh's submission, I was commissioned in that capacity to undertake a study of the position of contract research staff at the University of Edinburgh with a view to the university considering the management of the careers of these research staff in relation to the university's strategic goals.

(*Dr Truman*) I am Donald Truman. I am currently Vice-Dean and Vice-Provost of the Faculty of Science and Engineering. I was trained as a biochemist. I was in the Genetics Department in Edinburgh for a long time. I finished up as Head of Department and so have some experience of a department with a fairly high proportion of contract research staff. Currently my responsibilities cover all of the departments of science and engineering. I get involved in the appointment of new staff and staffing issues variously at that level.

922. Would you like to make some opening statement?

(*Dr Dow*) Very briefly. I think the first thing that should be said is our thanks for offering the University of Edinburgh the opportunity to contribute to these discussions. The university is approaching the issue of the employment of contract research staff, and indeed other categories of fixed term staff, from two perspectives. We are evolving our research strategy at the moment. We are also evolving a more coherent and more harmonised approach to staffing policy. From these twin perspectives the role of contract research staff has figured very large. As I have already said in my introduction, my concern has been principally with the devising and determining of its staffing policy. I think I would just like to set the framework in which our deliberations have proceeded by saying that we feel that there are three considerations in this matter which in principle and in the ideal world we would like to think of as complementary but which in practice are very often competing. The problem is in getting the three considerations in the right sort of balance to meet the needs and the situation of the university. A colleague of mine expressed these three considerations as a rather catchy slogan: justice, quality and prudence. By that he meant that we should be aiming for the appropriate balance of justice for the individual; that is in terms of the individual's conditions of employment, entitlement to have a decent career prospect, decent personnel management while employed by the university and justice for the individual. Secondly, quality, a word you have already used, for the institution: the need to enhance the quality of the university's research activity; the nature and volume of its research activity and the quality of that research activity as one of the leading research universities in the United Kingdom. Quality also in terms of its human resource management. The institution's interest, if you like, is quality as against the individual's interest in justice. The third consideration, and one which in practice tends to dominate thinking in higher education at the moment, is that of prudence, financial prudence particularly, prudence in the face of the funding environment with which higher education is faced. We are attempting to carry forward thinking about the issue in relation to that very general framework. We also in our mission statement as a university see the teaching and the research functions of the university as in principle indissolubly linked. We consider that we carry on teaching in a research-led environment. We consider that we promote the advancement and the dissemination of knowledge in a context in which teaching provision is one of our key concerns. So the linkage of the teaching and research functions of the university, and hence the linkage of these functions in terms of the responsibilities of individual staff groups, is something else which we feed into our thinking about contract research staff. I think that is a very brief summary of the over-arching framework within which we are thinking about these issues and perhaps that is a sufficient introduction.

923. Thank you very much for that very clear exposition. Dr Truman, would you like to add anything?

(*Dr Truman*) No, I have nothing to add at the moment.

924. I think you put it very succinctly indeed as justice, quality and prudence. We understand all that. There are, however, two questions which come to mind at once. The first one is in terms of the linking of teaching and research. With an enlarged system which now exists one cannot apply this general principle throughout the whole system without having the research rather thinly distributed over all the universities so some choices have to be made. I would like to ask you how you see those being made? Secondly, may I just say, since you yourself referred

[Chairman *contd.*]

to it rather obliquely, that one of the problems why this has been thrown up is that the universities have been under financial pressure for some time and have seen the only opportunity—apart from enhancing those students who pay full cost fees, namely mainly overseas students—of getting higher ranking in research as attracting more money from the Funding Council. Particularly is this true in Scotland although you do have an element for teaching in that funding, the quality of teaching I mean? The incentives are very strongly for the university to get more money that way and therefore to appoint such people who do not come to them permanently on their staff. There are advantages for the university. How has this, in your view, to be managed, bearing in mind that we have read your submission? There I notice that you say on what I now realise is the justice of your three things, that there has to be some better management of those staff which takes account of their rightful needs. You refer extensively to the University College London exercise which has attempted to do that. You also refer in section 5 to the necessity for bridging and the parallel funds as a kind of little pocket of money which enables you to tide people over from one problem to another perhaps even leading ultimately to a sum of money which enables you to identify those whom you would want to employ. Would you like to tell us more about that?

(*Dr Dow*) Perhaps I can take some of your more detailed points that you mentioned at the end. I think if a university is, in the interests of the enhancement of its research activity, looking to contribute some of its funding from funding council sources to the sorts of bridging or underwriting schemes that we mention in our report, then the question has to be raised, to put it simplistically, "Where does that money come from and what else is not being resourced as a result?" I think it is very interesting that in the University College London scheme, for example, and indeed in the Warwick Research Appointment scheme, to which you referred in your preliminary question paper to us, that the consequence of devoting funding to enhancing the conditions of research staff is to get these research staff to contribute to the teaching provision of the university. That raises a big issue about the legitimate career expectations and the strategic deployment of the skills of people whom we call research staff but who may also be spending quite a lot of time teaching. The Warwick scheme, as you will be aware, provided for each fellow to perform up to one-third of a teaching load and the University College London scheme envisages the strong probability that all research staff from the point of appointment will undertake some teaching duties. I think immediately when one is into that scenario one is asking if this is in the best interests of (a) teaching (b) research and (c) the individual's career expectation. Certainly I think the universities have to grasp this nettle and I think the way forward probably is to think of some more flexible mix of duties both on the part of some research staff, not necessarily all research staff, with its counterpart being to examine the mix of duties of so-called academic teaching staff (lecturers that is) whose contracts also require them to spend a significant proportion of their time doing research. So the totality of research activity in a university is clearly not, as I appreciate you are well aware, simply a function of the efforts of the contract research staff.

925. Would you imagine the university paying for the services in teaching of contract research staff over and above what they receive for supposedly their full-time employment which is contract research?

(*Dr Dow*) That is something on which we do not yet have a clear position. The practical matter in the University of Edinburgh is that depending on the particular situation of the researcher and the constraints which are placed upon his or her activity by the funder, some research staff are paid extra for teaching duties and others are not. I cannot give you more systematic data on that, I am afraid, because I do not have it and a study has not been done. Ideally if one is thinking of a situation in which extra payment is being made to research staff for additional teaching duties, that raises financial issues in itself.

926. There are other issues too, of course, because some permanent staff might feel this was a kind of cheap labour situation which was being exploited and there is no doubt that many of these contract research staff already feel there is a degree of exploitation because they consider that on academic age rather than chronological age they are less well paid than the academic staff and, of course, there is less security of employment. On the other hand, if they do not do some teaching they are never going to establish their claim to have teaching experience.

(*Dr Dow*) I would accept that that is a practical dilemma at the moment and I would not deny that some research staff feel that this is not an ideal situation for them. Yes, you correctly pick out something which I think is implicit in the report. Dr Truman may have more practical evidence of how this works out in a particular research context.

(*Dr Truman*) I would like to add that in the Faculty of Science and Engineering I think the majority of contract research staff do very little teaching, if any. It varies somewhat from department to department as to how the departmental traditions arise. In one department, for instance, it has become a custom that they do the odd tutorial or something of that kind. There is fairly often a request to get a little bit of teaching experience to enhance their CV and there it would perhaps be hard to distinguish whether they feel they are under pressure from the department or not. I think really they feel under pressure from the system and the wish to enhance one's CV may be a feeling that in fierce competition for permanent academic posts it is the system which is putting that pressure on them. I think some of them actually enjoy teaching, but we are aware that their funding agent would be nervous if more than a very small amount of teaching were done.

927. In the old days it used to be standard practice, of course, in science and engineering that a "funding agent" would permit something like up to six hours a week teaching.

(*Dr Truman*) Certainly that is the sum mentioned for a post-graduate research student. For research post-doctoral fellows I do not know that any number of hours is specified these days.

[Chairman *contd.*]

928. It can be negotiated still with the person who provides the money, can it?

(*Dr Truman*) Yes.

(*Dr Dow*) May I add to that that in talking about teaching we may have had undergraduate teaching in our minds, but another aspect which crosses research and teaching is PhD supervision and there again we have another issue which I think needs to be explored. The legitimate role of research staff in the supervision of post-graduates is itself a way of enhancing the research activity.

929. Does the University of Edinburgh allow a contract researcher to be officially a research supervisor?

(*Dr Dow*) I think I am right in saying that someone who is on a short-term contract would not be eligible to be a principal supervisor. The key thing would not be any feeling that research staff were less worthy, as it were, than lecturing staff in academic terms to be supervisors. It would be the question of the length of contract; does the length of contract enable that person to supervise the PhD to completion. I think certainly a role as second supervisor—we insist on there being two supervisors who are not of equal status—would be a possibility if the term of contract allowed.[1]

930. Some of the grant awarding bodies, research councils like the MRC, the BBSRC and some charities like Wellcome, are moving towards, for exceptional people, five-year contract research. They would have the possibility of doing supervision, would they?

(*Dr Truman*) I do not think I know of any instances where currently there are supervisors in a known and formal sense, but I think it would be quite hard to draw the boundaries in a laboratory subject between, at the one end, the formal supervisors with responsibility for the overall direction of the student's work and those things which happen at the bench showing how to do so and so, where I think the post-doctoral presence is very very valuable and takes a considerable burden off the shoulders of the principal supervisors who indeed may well not be in a position to convey some of the expertise that the post-doc fellows would have. I think in the laboratory environment there is a continuum from maybe an Honours student doing a project through to a PhD student, the post-docs and the academics staff where there are no clear demarcations.

931. Is there a degree of justice in the sense that the contract research staff member then becomes a co-author in any published work?

(*Dr Truman*) Yes. I think that on the whole is a pretty well universal practice.

932. I wonder if you would like to comment on why it is in the University of Edinburgh you have yourselves increased your staff to the numbers that are given in your report? What have been the forces behind that driving it?

(*Dr Truman*) I think success in applications for research funding.

933. You mean the desire to get more research money in?

(*Dr Truman*) Yes, to put forward projects to which we are committed where post-doctoral assistance is part of the project. That has been, certainly on the biological side, where our numbers have built up some quite large teams led by permanent academic staff where there may be a number of sub-projects often with substantial inputs from the scientific direction by the post-doctoral workers who themselves range quite a lot in age and experience; some immediately after their PhD, others who may have held a couple of post-doctoral fellowships before they even come to Edinburgh. I think that as an institution's research pattern and reputation build up so one gets quite a rapid growth of successful research teams which build up the numbers of contract research staff.

934. This really means that you have a built-in desire to keep strong research both for its intrinsic value and because of the benefits it brings in money from two sources at least, one of which is the actual grant awarding body itself and the other is the Brownie points which arise from the funding from the Higher Education Funding Council if you get a good research reputation?

(*Dr Truman*) Yes. I think that distinction is an important one because the actual money for the research is very largely consumed in carrying out the research. The additional reputation has advantages not only in our area but also in attracting the best quality of undergraduate students and the best quality of research students. 935. Many of these contract research staff say that there are forces in the system as it now is which work against the quality of research. For example, they are themselves on a two-year contract. Part of the first year is settling in. You do not get results for a long time and then in the second year they are thinking, "Where am I going to be employed in the year which follows?" There is that kind of uncertainty which leads to lack of commitment. Then there is the pressure, "Well, I must produce something," so there is the tendency to go for the safe, unadventurous research. Is that your experience?

(*Dr Truman*) I would agree with all of those. I think particularly with a contract as short as two years the actual valuable productive time might be limited. It depends on whether you are bringing in somebody who has already got good experience and skills or whether you are bringing in somebody who has to learn a lot in that particular laboratory.

936. This brings us back to how can the University of Edinburgh manage these things better? I am not making that remark as a criticism because it is fairly common.

(*Dr Truman*) I think the first reaction would be to try to lengthen the contracts so that a greater

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[1] At present, the University of Edinburgh allows research staff to be appointed fairly routinely as second supervisors, although practice varies across faculties. Some senior research staff are appointed as principal supervisors, but only after the central university committee has examined their CVs and their previous experience of supervising and examining. All of these appointments are of course within the contractual period of appointment of the staff member concerned, and the university normally expects back-up from permanent members of staff.

[Chairman *contd.*]

proportion of that time is in the middle period. I take your point both about settling in and beginning to look for the next contract. There was a time when the post-doctoral fellow could be fairly confident that when they finished one contract there would be another one either there or somewhere else or there would be a permanent job. As the employment situation has got harsher so the temptation to look for another job early has increased and one then finds oneself in the position of losing somebody who has acquired skill being left with a short period of contract at the end which you cannot effectively utilize. You cannot get somebody to fill up that odd nine months or something at the end. I think the change in climate has meant that a system which probably worked fairly satisfactorily back in the 1970s is increasingly showing weaknesses as the career prospects cause the post-doc fellow to be less certain and less committed to his work.

937. Will the university sequester a small proportion of its income in order to provide these bridging or parallel funds to cover this kind of situation? Has it got a policy to do that?

(*Dr Dow*) I think we would take the view that in general a longer-term relationship with our staff is dependent on a longer-term relationship with our funders. The biggest single factor which could influence the situation for the good of the individual and for the good of the continuity of research activity would be if, say, there was to be more funding on a programme grant basis than a three-year project grant basis. One of the things which has certainly struck me in my work, and I think Dr Truman concurs with this, is that a five-year horizon seems so much more satisfactory than a three-year horizon. I do not think in discussing issues of career management it is necessary to get into very stark either/ors of either three years or contracts for life. I think a five-year horizon for staff, for the project, whatever, is much more satisfactory. As I have said, the key thing would be a longer-term relationship with the funders, but the university I think can also look at mechanisms of, say, rolling contracts. That I think is something which we do use very successfully in areas where there is programme funding in our inter-disciplinary research centres, for example, in our Artificial Intelligence Applications Institute, both of which Dr Truman has more knowledge of, where the ability to keep staff on, subject to a suitable performance review on a rolling basis so that they always have a reasonable career horizon—if the horizon drops to one year it is then moved to two—is a very practical step forward which should be explored rather than thinking in the more ideal situation of putting a group of staff on permanent contracts which, quite frankly, is not for any significant numbers a feasible proposition in the near future.

938. That is a very interesting idea, but I must put to you that part of the increase in funds which has come into the universities in recent years has come from non-grant awarding bodies as normally thought of, namely the increase has been from industrial firms and so forth and they generally (not always) are looking for short-term ones, particularly in the applied end of science activities from the universities, almost as if they were buying services, and that then becomes difficult to manage and presumably Dr Truman can tell us about that.

(*Dr Truman*) It is within our university and faculty a comparatively small proportion of our funding. The bulk of our research funding in science and engineering is a combination of research councils and the Wellcome Trust. On the engineering side, yes, we do have experience of industrial funding. The larger companies, the Shells and BPs, have a fairly long horizon. Perhaps because we do not have a lot of local industry we have not developed many research relationships with small and medium-sized enterprises.

939. Some people would argue that universities really ought to be looking for the SMEs because they are the seedcorn of future growth and could help them forward. Do you feel that in the University of Edinburgh?

(*Dr Truman*) We have talked about this significantly recently and, indeed, were I not here I would be at another meeting which is exploring the possibilities of developing those relationships. There is a geographical factor. We are not surrounded by science and engineering-based industries in Edinburgh. Our experience has been that the short-term view and the seeking for very applied and very specific solutions to problems has not really fitted well with our general academic thrust. We have quite a lot of relationships with industry in terms of teaching schemes, the LINK programmes and so on, particularly on the applied science and engineering side, but I think it is fair to say that that is still a minor proportion of activity in our faculty.

940. Some universities do it by providing consulting and testing services and things of that kind. Could you not? It would give you a little buffer of the money you could apply to help.

(*Dr Truman*) We are cautious about this. There is a kind of testing service activity where I think a university can be providing a service for industry, probably relatively inexpensive to industry, where the advantage to the university can be quite slight. The work may be routine science or technology. Most of the income gets absorbed in doing the job. It contributes little to the educational and fundamental research side of the university and we have rather fought shy of it. We have a unit within the chemistry department and there what we are looking for is the most advanced service provision to the most demanding customer rather than routine work. We have actually set ourselves up to seek out those people who are needing the advance services rather than the routine because of that philosophy we have.

(*Dr Dow*) We have a research policy working group sitting at the moment and the very issues which Dr Truman has highlighted are being considered, the whole relationship of other activities to the core fundamental research in which we are interested.

Lord Phillips of Ellesmere

941. Could we go back, my Lord Chairman, to an issue which Dr Dow raised earlier on about the benefits of longer-term support, particularly in the biological sciences. Over the years I would have said

[Lord Phillips of Ellesmere *contd.*]

that Edinburgh has been notable for having the full spectrum of modes of support from agencies like the Medical Research Council and the old Agricultural and Food Research Council in that there were a good number of post-doctoral research assistants on, say, three-year grants working with university staff. There were a good proportion of university staff who had been identified as excellent research leaders and therefore worthy of having programme grants of five years duration, usually on a rolling basis so that they were reviewed with the possibility of renewal for another five years. Going beyond that, there was also a good proportion of those people who would just be worthy of having MRC or AFRC units which have rather longer tenure, and then one even gets up to the level of almost research institutes within the University of Edinburgh. As the research councils see that, I think, that is in large part a process of selection of research quality, of research leadership, and it is a system that I think has worked extremely well. However, if one actually increases the proportion of people on programme grants, units and institute support, then I think within our limited financial framework there would be a reduced number of people on three-year appointments supporting not yet very well established research staff within the university. Would you actually be happy to see things move in that direction?

(*Dr Dow*) I certainly take your point that the whole question of flow is very important. One also does want to keep the versatility and constant refreshment which comes from the shorter term perspective. I do not know if Dr Truman has a particular comment upon our situation?

(*Dr Truman*) I think Lord Phillips has very accurately described how we are. I think, without wishing to sound smug, in a sense we would like to try to preserve that broad range of structure, recognising that in a sense it may be inhibitory of new opportunities and the opportunities for the new people who have not really established themselves. In terms of the point made by the Chairman earlier about a wider university system, I think we would be quite concerned that the funding of research should be directed predominantly in those areas and those institutions which have shown themselves to be effective in using funding in research. The notion that there might be an even spread of research funding over the whole of the university system on the grounds that that would be nice if everybody got an equal share would be very damaging to research units in university.

Chairman

942. Would it be damaging to research overall? Do you regard it as generality debilitating?

(*Dr Dow*) Yes, I would. There is a wide range of aptitude for research. Not everybody employed in the university system has the highest levels of aptitude and is most effectively using the money. One should put it in institutions which have those people with the abilities and creativity needed to use it and indeed also with the infrastructure and with the critical mass of people because the interchange of ideas is often a source of creativity. A few individuals working in lone fields in isolated institutions I do not think are likely to use the funding more effectively.

943. We are next going to see COSHEP. You also have your own funding council. Where are the decisions going to be made that will achieve your aim, given that universities are bound to feel, those who are not amongst the lucky ones, to be disadvantaged?

(*Dr Truman*) That part of research funding which comes from the Scottish Higher Education Funding Council is, I think, going to depend upon the quality of the research done and the statements that the Chief Executive gave us cause to be reasonably confident that the funding council does not take the view that everything has to be spread thinly and evenly. The other major source of funding decisions, of course, is the research councils where I think we continue to be reasonably confident that the quality of work done and the quality of proposals made are going to be predominant determinants of where the funding is.

944. There are signs that perhaps "new" universities are buying up, as it were, units with their own money in order to establish a claim on this. How is one to regulate that kind of activity?

(*Dr Truman*) The judgment of the research panels in the Research Assessment Exercise will be critical in this.

945. This is possible in a small system like Scotland because, of course, the people who are making the judgments know more intimately than they can in a large system with 100 universities and 60 colleges under the same funding council.

(*Dr Truman*) Yes, I accept that and, of course, the Research Assessment Exercise will next time round be judging a very much larger number of institutions. I am aware that people are being attracted sometimes by quite remarkable offers to carry out research in new universities, people with established records, publications and so on. I think that if this leads to the dispersal of effort for people who have been effective in a major research group being attracted to being a lone figure in a new institution it will be detrimental to the overall research effort because I think they will find it exceedingly difficult to be as effective in an isolated position as they have been in an established group with adequate numbers of colleagues with the right intellectual climate and the right resource infrastructure.

946. I noticed you were talking in section 2, second paragraph, about scientists being unwilling to make commitments to long-term projects and then I noticed in this very valuable annex which you have produced that, if I have got it right, some 30 per cent of your contract researchers are over 35 years of age. What future have they?

(*Dr Dow*) That, I think, depends on why they are over 35. Here I am thinking about it in the sense that it may be that they have not had a continuous career since graduation. I am thinking particularly of women who have perhaps come into and out of the profession, but perhaps I am misreading the thought behind your question, my Lord Chairman. Were you thinking that there are an awful lot of people hanging around for an awfully long time?

[Chairman *contd.*]

947. That is right and with a very insecure future. I also notice on the next page that 41 per cent of your contract research staff are women and I looked then to see whether they were predominantly in the over-age group. There is a slight difference in the age profiles but not as marked as I had expected. This has grown like Topsy and it has not been a matter of design?

(*Dr Truman*) No. I think that there are a wide range of types of people who will fall within that category. There are some who are international figures in their area who seem not to be unduly perturbed by the short term of their contracts because they are confident of their ability to continue. I recognise the population that Dr Dow described of people whose contribution may be on the more routine side of the work and among those quite a lot will be women who have returned to work having probably a PhD from quite a while ago and be willing to almost take any short-term funded job often because for family reasons they are in Edinburgh.

948. It would be useful if you could possibly make a division between those who are high grade scientists with original ideas able to bid for contracts themselves on their own merit and those who fall into the latter category which I might describe as a well qualified PhD running an NMR service and so on. The distinction of that breakdown does not appear in any of our figures.

(*Dr Dow*) I think the question must be, why are there apparently so many over 35s on junior grades. To turn your point round, I was perhaps surprised at this finding that there were not more older and senior researchers. That is the question, what has happened to their career progression? Why are the over 35s on junior grades? I think the key issue to look at there, although it may sound a little hard, is are there over 35s who should have been counselled out of continuing as researchers? One is making no judgment as to the satisfactoriness or otherwise of that particular population at the University of Edinburgh, but the question really is, are there people who have carried on from contract to contract in a very piecemeal fashion who would have found greater personal and professional satisfaction in a different career and perhaps therefore have released their place for someone with more to offer and who was perhaps more adaptable, more versatile or whatever. The question really is about the over 35s who are on junior grades, I think. That is a key issue.

949. This brings us on to career management. It does seem to me very important for all of you to achieve justice for these people. Is it not important to give counselling to all of them to give some indication of what their latent talents of ability and personality are that might guide them into other careers if they are not adapting to this? Could you tell us a little bit about the counselling service? We do have a report which was given to us on it. What is the view of the university towards it?

(*Dr Dow*) I certainly think that the university and, indeed, other universities are going to have to think much more about the whole career counselling issue for research staff. I would set that in the wider context of appraisal, review mechanisms and counselling as a whole. Career counselling, I think, in good human resource management has to come out of mechanisms for positive and planned career management. The particular initiative, of which I understand you have got wind, as it were, is something which was pioneered by the careers service. It arose in response to requests to the personnel office from contract researchers for advice on assessment of skills and career opportunities. So far we have run four workshops of this kind. The next is in fact tomorrow. They have been successful. I would stress that one of the satisfactory things about the clientele so far has been that those who have come have not just been people in the very last month of a contract; the desperate individuals, as it were. The demand has also come from individuals who are thinking positively about their future career management and future career strategies, and that I think feeds back to my previous point that these sorts of endeavours must be located within a planned and structured review mechanism for the management of careers. One of the reasons why there have not been more workshops of this kind has simply been the funding constraints on the personnel office and the careers service.

950. And a little tax on the grant income that you get would solve that, would it not?

(*Dr Dow*) If it was not needed for other more worthy purposes. I am sure the careers service would agree with you, my Lord Chairman.

Lord Howie of Troon

951. I wonder if you could tell me something about the rolling contracts. I see in your paper that they are subject to annual review. Does it mean somebody gets a three year contract and at the end of the first year there is a review and then perhaps a year is added on or do you add on another three years or what do you do?

(*Dr Dow*) You can have different patterns, of course. There is not just one way of managing the rolling contract system. The issues are, from the point of view of performance review, to get the timescale right. I do not think we can get into a situation in which nobody is doing any research because they are always being reviewed all the time. That is perhaps rather flippant, but this is resource intensive both for the reviewer and the reviewee, so the thing is to get the staging of review mechanism right from the human resource angle and to match that to the funding horizon, as it were, so that your roll matches your funding opportunities. I would say that there can be several patterns to a rolling contract system. You can have a system in which the individual always has the same horizon, always has two years or three years, but you can have more of a dip down and then top up system. We at the University of Edinburgh would be examining different forms and there might be different forms in different parts of the university depending on the funding environment, for example. The key is adequate review mechanisms. I think review mechanisms are absolutely fundamental to a lot of things that we have been discussing this morning.

[Lord Howie of Troon *contd.*]

952. You talk about horizons and I take that point as a very important one. Would it be possible for somebody to imagine that an annual review gave them a one-year horizon?

(*Dr Truman*) I think the examples that I know of are the Artificial Intelligence Applications Institute, which in many respects operates in a commercial environment, is funded by the sale of contract research where I think the shortest horizon is two years. When it drops down to two years the individuals are reviewed and given a new contract. It is then extended to three years so that after 12 months it drops down to two and they review. In another institution, the Centre for Genome Research, which is funded from BBSRC with quite a long horizon, the individuals have a contract which I think is three years rising to four and then dropping down. We are aware that what one has to avoid is them being unsettled by the rolling contract and if they are people you want to keep that they begin to look elsewhere. The people in artificial intelligence are mostly highly skilled programmers or fairly confident that if they were not needed here they could go somewhere else. I think the confidence of the individual in their employment prospects to some extent can match what kind of contract they are willing to accept. We moved to the rolling contract in both those institutions fairly recently and it seems to have been accepted fairly readily by the staff concerned.

953. Talking about funding from industry, which you mentioned earlier on, I wonder if in Edinburgh the engineers get any research projects coming from the off-shore industry, and if in that respect you co-operate with Heriot Watt or do you compete with Heriot Watt?

(*Dr Truman*) We have a joint organisation called the Petroleum Science and Technology Institute (PSTI), which is a joint body with Heriot Watt with its own Director who was jointly appointed. It funds quite a lot of research which is attracted from the oil industry and to some extent the two institutions are complementary. On the exploration side our department of Geology and Geophysics is the predominant beneficiary of that. Heriot Watt benefits mostly on the structural engineering side and then when the oil is ashore our chemical engineers benefit from it. The contracts are competed for, but to some extent the structure of the two universities and the expertise is complementary over a lot of areas. We are not substantially into structural engineering on the off-shore side.

Lord Haskel

954. I wonder if I could bring you back to these workshops and try to probe a little more the outcome of these workshops. Obviously they are very well subscribed and are very popular. Have a number of researchers faced up to the fact that they are not going to get permanent positions and have they moved elsewhere or do a number of researchers say they are quite satisfied with being short-term researchers and they are happy to continue with that?

(*Dr Dow*) I regret to say that we have not done a follow-up study on the people who have been on that actual course partly because, as I said earlier, it was not the case that they were all coming just to the end of their contracts, as it were. In looking for next destination statistics, for example, the careers service tell me that this coming summer would be an appropriate time to undertake a proper evaluation and follow-up study. I think also, and I regret this also as we have said in our initial memorandum, there is very little systematic data on the subsequent careers of scientists who leave contract research from the university. I think we have to accept that that is a gap in all our knowledge. I know there have been some national studies, such as the one undertaken by the Institute of Manpower Studies at Sussex on the destinations of graduate scientists, but that is clearly something which we should know more about and I think something which has figured in the discussions of the CVCP research council's working group that perhaps in future grant holders will be required to report on this sort of matter in their final report. Perhaps a word of warning: on many of these things we have to face up to the fact that the more time and the more resource in the most general sense that is spent on the management of research, perhaps the less time is spent by senior people on research. As Convener of the Staff Committee I applaud all the things about review mechanisms, career management, final reporting and what have you. All these things are, of course, immensely laudable and necessary but they are not cost free in terms of the most precious resource of all, time, and so it is a constant balance. I hope, to return to your question, that there will be a follow-up of the workshop participants this summer.

Lord Phillips of Ellesmere

955. Would you agree with me that there is in fact a conflict of interest within the university about the management of these research staff? Science has a great tendency to grow. Historically it has doubled in volume every ten years over the last 300 years, something of that sort, and that, despite funding pressures, seems to go on and it is partly the increasing availability of projects to pursue the greater background of scientific understanding that develops and so on. Let us turn particularly to the funding councils rather than the research councils and the research assessment exercise; here the individual research group leader or department leader, or whoever has the system organised in the university, is under considerable pressure to produce a volume of acceptable research work. I say acceptable because I know we are all concerned about the quality, but it has to be acceptable in terms of the funding exercise to produce quality rating which will lead on through the funding formulae to a good allocation to the university. In order to achieve this the research group leader needs a good collection of graduate students and post-doctoral research assistants. With respect to the remark you have just made about management, I suggest that a great many of your research leaders in the university as compared with, say, 30 years ago, are actually research managers rather than people who do the work themselves to any great extent.

[Lord Phillips of Ellesmere *contd.*]

(*Dr Dow*) Yes.

956. All of that is necessary to produce a good research assessment rating and having a lot of post-docs and graduate students also influences the funding formulae rather splendidly. When the processes are gone through and five minus one is multiplied by a proportion of post-docs and whatever the key dimensional number was then you get a very good allocation to the university. That is a very considerable pressure on the research group leader and that person is bound to be very interested in retaining useful research staff. There are many people who make a useful contribution as research staff because of the particular skills they happen to have acquired up to the age of, say, 35 or even 40, before things move on and they have not any longer got the right skills and they become comparatively useless. The research leader is not going to be very perceptive about that. There needs to be, in my view, a countervailing influence from the university somewhere that has responsibility for saying to these people, "Alright, your research group leader needs you or thinks he does but you are getting into a position where there is no future for you." There is a conflict here and I think the university has some responsibility for resolving it. Would you agree with that?

(*Dr Dow*) You put a lot of weight on the minor volume indicator part of any research funding.

Chairman

957. Minor volume—

(*Dr Dow*)—indicator. I am referring to Lord Phillips' remark on the part which the numbers of research assistants play in the overall funding methodology. I did not mean to detract from the main thrust of the question in saying that. I am interested in the analysis of the dilemma which you give.

(*Dr Truman*) That particular issue of the responsibility of the university as compared with the research group was one which some years ago was tackled by imposing an age limit on re-appointment to post-doctoral positions. At that time it seemed an appropriate way forward. It subsequently was dropped because it could not be operated with fairness, but that was the university's response probably 15 years ago to recognising that we were in danger of allowing people to drift into a career dead end and what the university said was, "Well, we will not re-appoint people. They should at that stage be going out somewhere else." As the climate of job opportunity changed it was put to us by the research staff that that was in itself an unfair way of dealing with it and so simple a formula could not work. I accept the point that the university needs to find a way of exercising that responsibility. I think it is to the benefit of the university that we sustain a healthy kind of structure in the research population. I do not know that we have an answer, but could I, not meaning to deflect the discussion, draw attention to one of the advantages that we have in Edinburgh, that the university is by no means the only player in the game and that quite a number of people move from the university at the post-doctoral level to the other research institutes, particularly in biological science, around the Edinburgh area, and there is a fluid population and to some extent I think what has happened in the past has been that the research institutes funded by the research councils have offered an opportunity to people who have left the university. They are now in some respects rather more like the universities because they have less core funding and a greater proportion of insecure posts in the research institutes, but certainly there are—on the basis of not a systematic survey but of my own knowledge on the biological side—a lot of people who having spent time in the university have then moved on to the research institutes.

Chairman

958. Is this known as the transfer of your problems to somebody else?

(*Dr Truman*) Yes, it is.

959. But not a solution of them.

(*Dr Truman*) In the past I think it worked better and I think the changing climate in the research institutes is meaning that it is no longer a solution.

Lord Phillips of Ellesmere] There is now about the same proportion of people on short-term contracts in research institutes as there is in the university system.

Chairman

960. We are coming to the end of our time and there are two matters we must explore with you. The first point is referring to the problem of women in science. We have heard a lot of that in recommendations from other bodies and we think we have a grip of the problem in many ways, or understand it. Is there anything which you, Dr Dow, want to say about that, briefly, that you think we may be unaware of which you have come across in Edinburgh?

(*Dr Dow*) I think I would simply like to add to the comment that we made in our initial memorandum and that is that I think the issue of positive discrimination is a very tricky one. We said in our memorandum that there may be a case for it to push forward an equal opportunities policy. I would prefer to identify what it is within the structures, whether they are social structures or academic structures or whatever, that lead to possible inequalities in terms of gender or race or whatever, and change these structures rather than to keep the structures and positively discriminate within them. I would simply want to register that caveat in terms of our original memorandum. Dr Truman may have a more clear-sighted view of women in science.

961. I think we have heard this point of view before and some people would go so far as to say that positive discrimination may in fact be an injustice.

(*Dr Dow*) Yes, I accept that. None of us who are concerned with the issue think it is an easy one.

(*Dr Truman*) The only thing I would want to add is that I think the imbalance of gender in science and engineering goes rather a long way back in the educational system. I recently finished interviewing a large number of applicants for a lectureship in

[Chairman *contd.*]

mathematics and certainly none of the short-listed candidates were female. In engineering we have seen a surprising growth in the number of females who we have actually appointed, and one recently turned us down. In the physical sciences I think the interest shown at the school level is showing a gender imbalance which is not to be seen in biological science. Our biological science intake of undergraduates is balanced. In physical science it is not.

962. We have this question of the MRes, Master of Research. What is the view of the university on this? We do know, of course, that the research councils have announced some places in which pilot MRes courses are going to be undertaken. What is the view of the university about it in general, not just the pilot scheme but its utility?

(*Dr Truman*) I think it remains to be seen what its utility is. Our initial reaction was that we would actually like to see the enhancement of the PhD by the steady development of useful and relevant taught components of the PhD spread throughout the three years because my own belief, and that of a lot of my colleagues, is that the relevance of some transferrable skills training becomes more apparent as a student progresses through the PhD. It is easier to train people to communicate when they have got something to communicate, for example. We were very willing to give the MRes a test and we applied it on a number of the pilot schemes of different research councils. We were short-listed and I think quite close on EPSRC. We did not get down to the final list. We were successful with the NERC bid and received ten studentships. The interesting thing there is that my initial feeling was that the MRes might attract students who did not feel that they were strong and would use it as a device to increase their chance of getting into a PhD. It has not proved to be the case. The applicants that we are receiving for the MRes programme funded by NERC are very good indeed. I think the real test will be whether the best students want to go through that route. I am being surprised, I think. I was initially rather cynical. We are keeping an open mind.

963. Of this cohort of students to whom you have referred, do you know what proportion of them is doing the MRes as a prelude to a PhD or as a qualification in its own right not to be followed by a PhD?

(*Dr Truman*) I do not know, but my belief is that they are mostly aiming to do a PhD.

Lord Howie of Troon

964. I see in your reference to the MRes you suggest that the modular structure might facilitate the growth of problem-solving perspectives. I wonder what you mean by that and in what way does it differ from other scientific degrees which presumably have some problem solving aspects in them?

(*Dr Truman*) What we envisage with the modular structure at this level is that whereas a student in one discipline will clearly have their research project in that discipline and quite a lot of the scientific content would be related to their own discipline, there would be other skills, the transferable skills, the management and other components, intellectual property rights, the broader elements which we would teach across disciplines.

965. I can see the inter-disciplinary bit. The problem solving is bothering me a bit. How does it differ?

(*Dr Truman*) I think our belief is that the inter-disciplinary component would generate a different outlook on the problem solving, that there is something for a biologist to learn by tackling a problem alongside students in physical sciences and that they have something to learn from one another because of the slightly different ethos and disciplinary background.

(*Dr Dow*) It is a question of making more explicit things which are implicit.

Chairman

966. We have had a long discussion and overshot our time, but it would be unfair if I were not to ask you again whether you think there are points you would like to make to us which have not come out in the discussion we have had so far. Dr Dow?

(*Dr Dow*) No, thank you. I think we have had a very fair and open and enjoyable discussion and I am satisfied that you have covered most of the points which are of concern to the University of Edinburgh.

967. Dr Truman?

(*Dr Truman*) In a sense it is a question to Dr Dow; that is, whether there would be any possibility of further analysis of our data on that population of contract research staff who are over 35. If we could do that then I think it might illuminate the discussion that we have had.

968. You are free to send in anything of that sort to the Clerk of the Committee and we shall consider it.

(*Dr Dow*) If it is your wish as well as Dr Truman's then I will see what can be done.

Chairman] Thank you very much for coming.

Memorandum by the Committee of Scottish Higher Education Principals

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

The problems of the current career structures for academic scientists are low salaries, long salary scales, very high teaching loads, low operating budgets and low probability of success in winning Research Council funding.

Overall there is a distinct lack of career structure for academic scientists. Resource constraints have restricted the number of promoted posts and also increased the number of contract appointments.

The uncertain funding climate both for research and for teaching within universities will make it more difficult to attract and retain high quality young people. It would be helpful if bridging funds could be provided to retain people between short term contracts and it might not be inappropriate if the research councils had such funds available for which institutions or individuals could bid.

The major problem with the present system is probably that there *is* no career structure for research scientists within universities—except by virtue of appointment to academic teaching positions. It is unreasonable to assume that all scientists make good teachers, or that the best can be got from them as researchers when they have a major teaching commitment. It is often—the market forces vary from time to time and subject to subject—a problem for postdoctoral (RA IA) researchers to find suitable academic placements.

The advantages are that employing organisations are able to select the most successful of the many strongly competitive research scientists. The relatively large number of appointments being made allow career movement between Universities.

Most academics are probably paid less than equivalently-qualified or experienced people who, in their own career-planning, have given top priority to obtaining highly paid positions. The fact that many academics are "unworldy" in financial terms means that they may fail to recognise and exploit the opportunities which are presented by their discoveries. This argues for making academic life more financially rewarding and thus encouraging more financially aware people to enter it.

2. *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

The disadvantage of short term research contracts is that candidates are no sooner established into their project than they are forced to start seeking their next source of employment. This can detract from their effectiveness and commitment and indeed may result in the most able candidates turning away from a career in research. The potential advantage of short term contracts is that it allows department/institutions to evaluate candidates prior to considering any long-term appointments.

The growth in short-term contracts applies not only to externally funded research staff, but in the appointments of academic staff in general. The advantages for the institution are flexibility and the facility whereby, in response to unexpected funding reductions, staff numbers can be reduced at short notice. The disadvantages for the researchers are insecurity and uncertainty. The disadvantage for both the institutions and the researchers is the relatively high proportion of time which fixed-term staff devote to preparing grant and job applications.

3. *How do you expect the situation to change in the next decade?*

Assuming the that the imposition of "efficiency gains" continues as at present, more time will have to be spent teaching and further concentration of research funding will occur. Few of the new Universities will have much funded research and a number of the Old Universities will lose substantial funding to the elite group of research Universities, thereby reducing the range of institutions permeated by a research culture. Replacement of staff in Univesities despite the current age profile will be steady and not, as predicted, peak over a period of 2–3 years. However, the cyclical international expansion of higher education reflected in the current academic staff age profile, will result in a highly competitive recruitment market.

It is suspected that there will be an increased tendency to make contract appointments as financial constraints continue to dominate. Over the next decade many academics will be retiring so the opportunities for employment (including promotions) in academia is however likely to increase.

As the amount of research money reduces and academic staff have less time to pursue research themselves it it likely that there will be less speculative research which will be very damaging to science. Permanent researchers with a remit to develop further research projects and bid for funding rather than attached to specific projects would go some way to countering this tendency.

Movement between academic and industrial careers is, if anything, becoming more difficult. Those with experience in industry, or even in research institutes, are rarely under the same pressures to attract external funding and to produce refereed papers as are young members of lecturing staff in universities. On the other hand the pressures on staff within universities leads to difficulties particularly of engineers since the academic track almost certainly delays their gaining Chartered statust due to the demands for a research qualification. This makes them less competitive than those who may have gone directly into industry on graduation.

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

There is only limited information available to this University but most candidates either gain employment in industrial research or academia.

There is no formal information on the destinations of scientitsts who have left the academic sector. Many move from one research assistantship to another while applying for lectureships. Few seem to move into industry and some eventually become school teachers.

It is well known that it is much easier to obtain support for PhD research than to gain an independent position as a lecturer or as a researcher attracting his/her own grants. The log jam at the postdoctoral/lecturer interface results, at least in part, from academics preferring to rely on temporary research assistants than on permanent technicians and scientific officers.

5. *What should be done to improve the mobility of scientists between academia and industry?*

Mobility between academia and industry would be facilitated by parity in salaries. Academic salaries would require to be increased by 20-25 per cent.

Appoint academic scientists and engineers to the boards of companies.

Academics and industrialists can learn a lot from each other. It is not self-evident that they need to change places to do so or that making it easy to change places will make the system better. It is important that in the early stage of planning their careers students gain clear insight into the attractions and disadvantages of all the options open to them and that they make career choices carefully. More CASE studentships and Teaching Company Associateships would help.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

It is still the case that career prospects for women are often limited by the fact that they may be less mobile and may not be given appropriate recognition following career breaks.

It is unlikely to change a lot. Possible ideas for improvement include, providing financial incentives (eg bursaries for female researchers, a programme of visits of "role models" to schools); designing undergraduate courses to be particularly attractive to women.

More women are having their families at an older age. Many women return to work very soon after the birth of their children and have difficulty in fulfilling family commitments and withstanding the pressures of academia. Scientific careers could be made more attractive if women had the automatic right to return to work at 50 per cent engagement and proceed to full-time work over a planned period.

It is quite difficult to interest boys (as well as girls) in science and engineering courses and careers and this looks likely to continue to be the case. School pupils should be helped at an early stage at secondary school to realise that choosing to study science or engineering gives them a wide range of career options.

Anyone who drops out of research for a lengthy period will take a long time to catch up on what has been happening in his/her absence. The willingness of employers to help people during career breaks will vary depending on the job market and availability of fresh recruits.

7. *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

The MRes has little or no support in universities and in industry. Industry sees no advantage in employing MRes graduates and prefer to employ PhDs. Universities see little need to invent yet another masters degree. The number of masters degrees is already causing confusion (MSc, MPhil, MSci, MRes) among potential employers.

This issue has been considered by the professional bodies, for example the Royal Society of Chemistry and the Institute of Physics, and the overwhelming conclusion was that it was not necessary to have an MRes as a precursor to undertaking a PhD. Given that the Government has now accepted that there is no need to extend the duration of the PhD, the value of the MRes must now be questionable and the award title itself may lead to increased confusion.

This degree is not very worthwhile and only appropriate to large research schools. This is yet another centralising tendency which attacks the diversity which is vital for the future of science and technology, as is the ability to try out unpopular ideas.

There is not enough money in the system to be able to afford it and already there is a problem with the funding of doctoral training, with the EPSRC and BBSRC being unable to afford adequate stipends to students (to match, for example, MRC stipends). This problem could be tackled *together with* the dead-end nature of postgraduate (RA IB) research assistantships. The latter should in effect be abolished, and be replaced by reasonably-funded studentships which would be linked to research grants and would lead to PhDs within the precise project area of the grant. Quota awards could be correspondingly reduced in number, and ultimately abolished.

It is important that professional researchers develop strong research skills but it is not clear that they will do this more effectively through following a formal course than through a self- and supervisor-regulated programme of personal development.

Examination of witnesses

PROFESSOR ALAN NEWELL, Deputy Principal, University of Dundee, PROFESSOR ROBERT CHAPMAN, Head of Physics, University of Paisley, PROFESSOR JOHN GUY, Provost of St Leonard's College, PROFESSOR F G MCINTOSH, Assistant Principal and Dean of Faculty of Science and Technology, The Robert Gordon University, PROFESSOR ALLAN BARR, Dean of Faculty of Engineering and Mathematical and Physical Sciences, University of Aberdeen, Committee of Scottish Higher Education Principals, called in and examined.

Chairman

969. Good morning, gentlemen. Thank you very much for coming. We were set up simply to consider this problem of the vastly and rapidly increasing number of contract researchers which by definition are those people who only have posts for two, three, four or five years at a time. There are many people, no fewer than 22,000 or so, in British universities who are now in this category who have no kind of security of tenure at all and are far worse off than the academic staff. They are therefore a useful reservoir of skilled people who help forward research work in universities, but questions arise as to the justice of their employment conditions and if they are not being exploited. One also asks the question why they are there and why they are not on the staff on a regular basis and what help they get in guidance in their careers and so on and so forth. It is not just a British problem. We have just been in the United States where it has also been recognised and they have attracted to themselves the term "gypsy professors" because they wander around following the research contracts, as it were, from one town to another. That is the background. What has to happen after we have reported is that the Government has to respond to both the report itself and its recommendations and also to the Debate which will take place upon it which, formally speaking, is a Debate to take note of, but it does require the Government to make a response and therefore brings into public view certain issues. These reports have varying degrees of influence, sometimes considerable, sometimes less. That is the general background. Professor Alan Newell, you are in mathematics and computer science, are you not? Where?

(*Professor Newell*) Yes. Dundee.

970. Professor Chapman, you are Head of Physics, University of Paisley, is that right?

(*Professor Chapman*) Yes.

971. Professor John Guy, you are from St Andrews and a historian?

(*Professor Guy*) Yes.

972. You say yourself you are the Provost of St Leonard's. I thought St Leonard's was a joint college with St Salvator's?

(*Professor Guy*) I think we are in the process of reviving it.

973. How did it lapse?

(*Professor Guy*) It was merged with St Salvator's in 1747.

974. I am so old I did not notice that!

(*Professor Guy*) We are hoping to revive it as a graduate school.

975. Professor McIntosh, are you from the Robert Gordon University and Dean of the Faculty of Science and Technology?

(*Professor McIntosh*) Yes, that is right. I am actually an engineer.

976. We understand that. Professor Barr, you are Dean of the Faculty of Engineering and Mathematical and Physical Sciences?

(*Professor Barr*) Yes, in Aberdeen.

977. Your own subject is?

(*Professor Barr*) Engineering.

978. Which sort?

(*Professor Barr*) Mechanical engineering.

979. I wonder if right at the very beginning I may make two statements, one in the form of a question, which is, would any one of you like to amplify or draw our attention to specific points in the submission which we have in front of us? Secondly, would you explain to us what is the Committee of Scottish Higher Education Principals which has recently been established? When you explain that would you say whether the Scottish universities are still members of the Committee of Vice Chancellors and Principals. We need to know this for the record.

[Chairman *contd.*]

Before you go on, may I just make one other practical point and that is that all that you say will be recorded by the shorthand writer and will be printed. You have an opportunity to correct what you have said for any mistakes in the printing or whatever or any lack of clarity. I would like you to know that beforehand. Who is your leader?

(*Professor Barr*) I have been chosen to sit in the centre seat. Perhaps I could just set the scene for you with regard to our own submissions in this meeting. While we are representing COSHEP here, there is not a party line that we are representing on their behalf. We have been chosen as suitable individuals to represent the views in an overall way of COSHEP.

980. Suitable on the basis of your coverage of knowledge?

(*Professor Barr*) Both on that and hopefully as individuals too. With regard to your point on the structure of COSHEP and whether the principals of the universities are still members of CVCP, I think the latter is the case. With regard to the details of the structure of COSHEP, if you do not mind I will ask Professor Newell to answer.

981. What its aims are in particular.

(*Professor Newell*) I think they are identical to those of the Committee of Vice Chancellors and Principals but because there was a separate Scottish funding council, and it is also a separate country, it was appropriate to have a committee of the Scottish principals. The Scottish education system is significantly different from that in England and Wales and it was felt that it was important that the Scottish principals should get together to be able to put a united front. In the past it had perhaps tended to be forgotten that Scotland did have its significant differences.

982. Do you, like the CVCP, therefore meet periodically with the Scottish education department and the funding council in Scotland?

(*Professor Newell*) Yes. But all the principals are also on the CVCP.

Lord Phillips of Ellesmere

983. There was an element of infinite regression in the answer in that I for one would not know what the aims and purposes of the CVCP were.

(*Professor Newell*) I am sure they have a mission statement, my Lord.

Chairman

984. I sincerely hope they do not. We have too many jargon words nowadays. I can confirm that having served some five years on the old CVCP, what their mission statement might have been constantly eluded me.

(*Professor Barr*) On the other issue, my Lord Chairman, of whether we have a presentation to make amplifying the statements already made by COSHEP; I think the answer is not, but we have a number of points which we would like to raise in discussion particularly aimed at answering the various questions which were possible on the agenda for this meeting.

985. So you will be content for me to guide you through these questions and any others that their Lordships would like to ask?

(*Professor Barr*) Indeed.

986. If we could just look at your responses to the call for evidence, I notice that in section 1, the third paragraph, you refer to the uncertain funding climate both for research and teaching within universities. In some ways it is more certain than it used to be, certainly more transparent. Some people have different views about the validity of the processes which are used to assess it. You do say that it would be helpful if bridging funds could be provided to retain people between short-term contracts. I think we understand that what lies behind that is your concern for these unfortunate people who do have very considerable difficulties. I suppose a person who would be on the providing end would say, "Well, you do get public funds and the universities should manage their funds so as to do this for themselves." What would your answer be to that within the present funding you have?

(*Professor Newell*) As the universities have got an increasing proportion of their funds coming from non-funding councils then the problems increase in that a much larger number of research people are funded from entirely external contracts and there are some problems in getting an appropriate level of overhead on those contracts; in particular medical charities and European Community research grants are a problem. That means that the amount of funding that the university has available for things like bridging funding is a much lower proportion than would have been the case when there was a better balance between funding council income and external income.

987. But the funding council would say that the more research you do, provided it is of adequate quality, the more you get from us under the formula which all the world knows about. Why cannot that be used or are you saying it is inadequate?

(*Professor Newell*) It is inadequate would be my view.

Lord Phillips of Ellesmere

988. Another approach would be to say that the trend in universities has been away from a few major block grant supports towards a much greater diversity of support so that you now have to manage two multiple funding streams. That is a situation which is extremely common in industry and within industry they manage to support their workforce to do the work that they need to do. Given that they have these multiple cashflow problems, why can universities not manage themselves as well as that?

(*Professor Guy*) My Lord Chairman, I think that attention is being given in some universities to this. At my own university of St Andrews we are considering the question of bridging funding for people on short-term contracts and this is a question that can be addressed at two levels: one is at the central university level and the other is in the academic unit, the school or department. Those departments which have devolved funds are able, in fact, autonomously to decide to retain contract

[Lord Phillips of Ellesmere *contd.*]

workers for a period of two to three months between contracts. The centre might help if necessary. Something that strikes at the root of this problem is the number of alpha rated projects that are not able to be funded by research councils. There is severe competition for funding so that it does become a matter of speculative guesswork as to exactly which alpha people one ought to seek to retain beyond a period of, say, three to four months.

Chairman

989. It would be true, would it not, that the smaller the university and the smaller the department, the more difficult it is to retain adequate funds at that level in order to do what you want? Coming back to your point, is there not a responsibility on the university as a whole, as it were, to tax the grant money or whatever to take care of this provision?

(*Professor Guy*) It is a difficulty with those charities or councils which do not pay overheads or full overheads because in a way we are burning the candle at both ends. A research university which wishes to maintain the numbers of research students at the pre-doctoral level working towards the PhD is probably using overheads actually to fund studentships in addition to the studentships which are obtained from research councils. We have started to do that. Therefore, the problem is that there are many demands on this pot and the pot is limited in size.

990. So the choices have to be made?

(*Professor Newell*) I think the industry would tend to charge a much higher level of overhead. Universities in the past have tended to calculate the overheads in a relatively straightforward way, whereas industry would take into account things like bridging funding and so on. In order for us to properly fund that we would need to increase our overheads significantly.

991. The charges to the people who give you the money or the research. On the other hand, it has always been the case, has it not, that universities have wanted to do the work for which they get money anyway and, therefore, in the past have been prepared to contribute some part of that cost with the general support grant from the department taking care of some of these costs? Is it now that it has become more explicit and is open to criticism in that public money may in the case of external bodies be supporting external bodies for which it was not intended?

(*Professor Newell*) This can be the case but also the general productivity increases that have been forced on the university over the past ten years have meant that there is much less effort available for doing these things.

992. That productivity increase is simply the result of diminishing the denominator which is the amount of pounds the Government is prepared to give for an activity. Is that right?

(*Professor Newell*) And increasing the number of students.

993. That is what one is saying. The costs are, of course, for the students as the staff and the staff student ratio has deteriorated. Is that not so?

(*Professor Newell*) Yes.

Lord Phillips of Ellesmere

994. Over many years I have been very concerned about this use of the word "overhead". In my view it is the business of universities to assess what are the full costs of the work that they seek to do and to acquire those full costs from the agencies supporting the research. If they go to an agency that says, "We will not actually pay the full cost but something less than that" for whatever reason, the university, in my opinion, has to bite the bullet and decide whether it can afford actually to take on that work. I do not see a great deal of evidence yet, though I am sure there will soon be some, of universities refusing to take on work which is not fully paid for by the agencies wishing to have it done.

(*Professor Newell*) I think that is partially because of our enthusiasm to do the work and organisations like sections of the Scottish Office not being prepared to pay for full overheads.

Chairman

995. Why should you say "fault of our enthusiasm" to do research within a university?

(*Professor Newell*) I was being ironic, my Lord Chairman.

Lord Howie of Troon

996. What does this researcher actually do during the bridging period?

(*Professor Guy*) This would vary according to the department subject. We would not wish to keep people for longer than three months. There are always tidying up things to be done and new grant proposals to submit, but insecurity of research funding is an important reason why there has not been greater activity in keeping people on because it is a speculation which could be compared to horse racing.

(*Professor McIntosh*) My Lord Chairman, I would like to widen the dimension slightly in that in some universities these researchers are also members of the teaching staff because of the particular balance of the university and they also will be on contracts. I would agree with your previous comment that the research monies through the funding council is now more predictable over a period of time. That is not exactly the same situation with the money related to the teaching function which can be extremely variable. This has led to many universities engaging young staff on three year contracts as academic staff with both a teaching and research commitment.

Chairman

997. On funding council money?

(*Professor McIntosh*) Yes. Those young staff are often the main contributors to research but if they come towards an end of a contract they are already

[Chairman *contd.*]

looking for new positions. If I can add in a slight Scottish dimension to that; it is recognised by a number of the universities in Scotland that to attract and retain staff is often difficult because of geographical perceptions.

998. Would you explain "geographical perceptions"?

(*Professor McIntosh*) Perceptions of remoteness, and I say perceptions. If one was operating within a high conurbation of activities of different research institutes or universities such contract staff may quite readily find alternative short-term employment until such times as they can be re-engaged again. However, that can be a problem with certain of the universities in a Scottish context where that opportunity may not be available to them. Therefore, one could have an excellent researcher who is perhaps also a teacher who finds, because of nearing the end of a contract, the need to seek alternative employment and geographically relocate. That is one of the issues that I feel we have to address.

999. Could I just put something into words which you said so we get it clearly in our mind. I get the feeling from what you said a little earlier on that in a sense the old teaching assistant post has come back into existence that used to exist in the universities. It was very limited in tenure, at the disposal of the professor doing research and doing something for teaching. Is that right?

(*Professor Newell*) Not usually at the disposal of the professor, but the institutions because they are concerned about the long-term funding will tend to offer staff short-term contracts because they are not sure where the next penny is coming from.

1000. From the point of view of the people so employed the professor is the natural head.

(*Professor Barr*) Can I agree with you, my Lord Chairman, because I was one of these assistants myself in the remote past and it is very similar.

(*Professor Newell*) May I take up one point from Lord Howie about what these people were to do? I think the answer is contained in a comment about the number of non-funded alpha rated proposals. Most university staff have got more than enough research that they wished they could do and there is no problem in finding really productive and particularly long-term work for these people without contracts to do. There is no problem with giving them work. It is simply finding money to keep them going.

Lord Howie of Troon

1001. Are you likely to have some kind of piece of research in a pigeon hole somewhere that could be decently tackled in three months? Surely not.

(*Professor Newell*) I personally start them working on areas where we can do a small amount of pilot work and develop a contract proposal. It would be those sorts of things that would be done.

Lord Redesdale

1002. You talked about the bridging facility so that you could keep these contract researchers within the institutions. You talked about it as if it would be an advantageous thing to happen. Does it exist at present in any form? We have heard a lot about the fact that the most valuable contract researchers are those with a good publication record. Would those be the type of researchers that would be most likely to be kept on so that they could attract further funding?

(*Professor Newell*) I do this on a monthly basis. When the contract research people are coming to an end I look at how much money is available to my research group and decide amongst the priorities, and one of the priorities is can I afford to let this man or woman go and how long can I keep them going. I think we do it at an individual level and I think some institutions do it at the institutional level.

(*Professor McIntosh*) My Lord, one mechanism for that is to seek to find that support through industrial sponsorship money, industrial consultancy, short-term consultancy.

Chairman

1003. That is more possible in your field than in others.

(*Professor McIntosh*) That, however, does have some mismatches because the individual who is a top level researcher with an excellent publications rate may not be exactly the right individual at that stage to take on the consultancy work over a short-term which has, of course, very very tight and specific delivery. It is a method, and it is a method we have used.

1004. A little lower in your submission in the same section right at the bottom you say: "This argues for making academic life more financially rewarding and thus encouraging more financially aware people to enter it." Two points about that: one, of course, is that this can only be in this day of limited public expenditure a pious hope. Would you not agree? Secondly, if you get people coming into academic life for the money, are you not losing a sense of vocation?

(*Professor Guy*) I would like to say for the record that I think we think the fundamental issue is that of the number of alpha rated projects that cannot be funded and, secondly, the short-termism, as it were, which is built into a system in which research contracts are predominantly based on three years rather than, say, five years. That is not to say that if a switch were made to five-year contracts that, say, for example, a two plus three mechanism might not appropriately be built in so that people who were not performing after two years could be replaced. After all, the research councils have themselves made some complaints about the amount of refereeing and assessment and the constant dissipation of effort which is actually based on constant bidding for new grant scheme funding.

Chairman] They have also stated to us that they have taken account of your points and are developing it.

Lord Phillips of Ellesmere

1005. I am a little concerned about some of the concepts that are appearing. In the first place, yes, of course there are far more worthwhile projects available to be done in science worldwide than can

[Lord Phillips of Ellesmere *contd.*]

possibly be afforded even though the scientific activity continues worldwide to double every ten to 15 years or thereabouts. That is an inevitable situation that we have to live with. One of the problems perhaps is again going back to the size of institutions. If you have, let us say, a very active biology department, the chances are that in some particular moment it has, let us say, 12 research grants operating. The head of that department will know at what point these research grants are going to come to an end and will no doubt, in association with his colleagues, arrange that they put in the appropriate applications for further grants which will usually be related to the particulars of the existing grants. The chances are, whatever the alpha funding problem is, that somewhere between eight and 14 of these renewal grants will be funded and it is this sort of management surely that has to be taken into account. I was extremely alarmed by Professor Newell's remark that he looked to see within a month or two of the end of a contract when that was going to come to an end and what he could do to keep the person doing that. The timescales are not like that.

(*Professor Newell*) I apologise for not having made myself clear, I said that I reviewed contracts on a monthly basis, but, when I said "contracts coming to an end", I meant that I reviewed future funding for any contract with less than a year to run.

1006. Continuously, in fact.

(*Professor Newell*) I apologise for that mistake.

Lord Redesdale

1007. What sort of percentage of your time do you actually spend in the management of research staffs' careers?

(*Professor McIntosh*) I have a responsibility for research strategy for the university and in that, through undertaking various research seminars and training programmes and so on, my personal time on that I would say would be perhaps barely five to ten per cent. That, of course, is only because I am involved at one level of that. There are implementation programmes that exist which do actually address such issues.

Chairman

1008. Could we go on a little bit on this theme? It does lead us naturally to a university taking a management role and responsibility for staff in this category if they are not to be, what shall we say, a surplus of labour in the old economic markets theory which is there ready to ensure flexibility and by that means it is exploited. In one sense it can be said that we may be wasting human talent. What steps are your universities taking? We have heard from Edinburgh specifically just before you came in about what they are doing in the sense of giving guidance to their staff, taking opportunities for workshops for them to consider their own particular careers and how they can think about themselves being generally helpful in ensuring that these people do have a realistic view of the life and the possibilities which are open to them, as well as managing those of very high quality which the university would like to keep in giving them some indication of what the possibilities are. Since you are COSHEP, is this a general situation throughout the universities in Scotland?

(*Professor Barr*) My Lord Chairman, I think that most universities have staff development programmes into which some of the research staff would be able to fit with advantages to themselves. I cannot say for the various universities just precisely what they do.

(*Professor McIntosh*) My Lord Chairman, I think that is a situation that will vary between different universities. If I refer to my own university; we have implemented for some time now a staff development career view programme which applies to all staff. We have now extended it to all staff, including all academic staff and researchers. This does involve an evaluation of that individual's progress. It is not an appraisal, it is an evaluation of their progress. It seeks to identify what actions are necessary to enhance their particular contribution to the work in the university.

1009. In the context of the grant which pays them?

(*Professor McIntosh*) Those in my university are mainly people funded through funding council monies either through the research assessment exercise or they will be on the academic staff who have mixed roles of both teaching and research. In that we are seeking to give guidance to them and give them assistance. Unfortunately, in some of those cases the assistance will be in the latter stages of a contract, more or less careers advice and career opportunities, but that is indeed in place.

1010. This would be generally for all of you, would it?

(*Professor Chapman*) My Lord Chairman, could I make the point that I do believe that making scientists aware of career opportunities in industry should start at the undergraduate level through activities like industrial visits, through industrial placements, which we do extensively in Paisley, either summer industrial placements or industrial placements for one year normally between the third and fourth year of the course, and also through the vocational nature of the undergraduate course. We also do employ industrial advisory boards, involving industrialists who advise us as to the continuing relevance of our courses from the perspective of industry. I do believe very strongly that one must start this process early on at the undergraduate level and not leave it until people are at the postdoctoral level.

1011. Would it be fair to say this is a natural outcome of the ethos of the institution that you have always been?

(*Professor Chapman*) It is, yes.

1012. Is there any danger now that you are under a common funding system that you will be tempted out of that mode into what one might call the traditional old universities role or is the process likely to be that the older universities will follow your example?

(*Professor Chapman*) I think one problem is that the RAE in its present form militates against collaboration with industry in its present form.

1013. Could you spell RAE out for the record?

[Chairman *contd.*]

(*Professor Chapman*) Research Assessment Exercise. That militates against collaboration and co-operation with industry.

1014. It militates against it?
(*Professor Chapman*) Yes.

1015. How does that come about?
(*Professor Chapman*) In my own subject, physics, the RAE seeks to identify peer review publications in high quality journals.

1016. Yet some would argue, would they not, that in terms of national good economy there are very great merits in taking account of the way in which the physics you do has benefits for industry?
(*Professor Chapman*) Yes, I would agree with your comments.

Lord Phillips of Ellesmere

1017. The English Funding Council has introduced a new element in the funding formula which I think is called GR (Generic Research) which is supposed to cover this precise issue. Has the Scottish Funding Council followed suit?
(*Professor McIntosh*) They have not formally announced that, but up to now the Scottish Higher Education Funding Council has used five per cent of the total research monies available to them for developmental purposes. The indicators now are very clear that in future years that same element of funding (which is about 5 million because there is in broad terms about 100 million on research from the funding council in Scotland) although not positively confirmed, will be allied to issues relating to the Government White Paper on Science and Technology and the Foresight Programme. May I also make the observation that there is not, in my view, a change in mission just because some institutions changed and put "university" in their name. It is my perception that the missions have remained very clearly the prior ones of institutions with firm industrial links. I do, however, feel that it is unfortunate in the research assessment exercise and, indeed, in the formula that the same weighting is not given to research grants obtained from industry to research grants obtained through research councils. I understand the argument it has put forward and that is that research grants from industry are not in full competition with peers, but I would suggest that if individuals do attempt to get research grants as opposed to contracts from industry then we will not find it a particularly easy task and they (industry) are certainly very very hard masters.

Chairman] This is a difficult road to walk. There are those who would say if they were civil servants that public money should not be used to subsidise industry directly by this route. On the other hand, there are advantages to the public wheel in having strong relationships between the universities and industry. Maybe you have to oil the wheels of the collaboration of the two by lubricating them with a little money from time to time.

Lord Haskel

1018. While we are on this subject and while we are in discussion with COSHEP, I wonder whether we could explore a little further what are the main differences between the English and the Scottish Higher Education Funding Council. We have heard about the teaching element, we have heard about the comparative isolation and you have just drawn our attention to the fact about research grants from industry. Are there any other differences that we ought to know about?
(*Professor McIntosh*) My Lord Chairman, to the best of my knowledge, there are not fundamental differences between the funding councils.

Chairman

1019. There is one fundamental difference and that is that teaching quality is a factor in Scotland and not in England yet.
(*Professor McIntosh*) It has given a certain additionality of funding through fully funded places for those gaining an excellent rating, yes, but our general view is that there are no fundamental differences in the funding structures between the Higher Education Funding Council for England and the Scottish Higher Education Funding Council that influence the issues that we are currently addressing.

1020. We are, I should explain, going to get from the funding council in Scotland their up-to-date position on funding and also from England and Wales which have a commonality here.
(*Professor McIntosh*) My Lord, there are differences in the two methods, but our general view is that those differences do not significantly affect the situation we are addressing.

Lord Phillips of Ellesmere

1021. The difference, of course, is that the funding formula in Scotland relies on a non-linear arrangement of the numbers rather than the English linear system which, if I have understood it correctly, would mean that the advantages to the highest quality universities are less in Scotland than they are in England?
(*Professor McIntosh*) Potentially, yes.

Chairman

1022. It is going to be very difficult the shorter funds become for those universities in Scotland who have not been so strongly research based to resist the temptation of getting more money by this means. Would you agree with that?
(*Professor McIntosh*) My Lord Chairman, it is the case and there again are indicators that selectivity will be a major criteria in future funding.

1023. On the basis of the institution?
(*Professor McIntosh*) Selectivity on the basis of the institution, correct, yes, and also the funding council, in my view, will seek to weight the formula towards the higher ratings. That, I confess, from where I come from, gives me cause for concern since many of the new universities did not benefit from government

[Chairman *contd.*]

funding on research in the past and, therefore, are developing at the present moment, and I feel that there does need to be a means in place to encourage those new green shoots. I think that would only be of benefit.

1024. This is a very difficult problem, is it not, because there is a limited pot of money and there is the danger that if you are not highly selective then the research which is done will be of lower quality because it will be more evenly spread around in inadequate quantities for anyone if one is not careful, so somebody has got to make decisions here. I rather understood from what had been said earlier that you were not going to be deflected from your main task as you conceived it to be.

(*Professor McIntosh*) The objective in many universities is to look for selectivity within their own strategy on research.

1025. Within the university?

(*Professor McIntosh*) Yes. Also, to not discount all other sources of research involvement, including direct research liaison with industry. In undertaking research in conjunction with industry I make a distinction between research grants and research contracts. In a research grant situation certain of the benefits and intellectual property, etc would rest solely and exclusively with the university. Therefore, it is not a matter of a properly managed university subsidising a commercial organisation.

1026. I wonder if I might just change gear a little and ask you your view on something which has been said to us not once but several times, which is that the general pressure on universities to get money by the research route has led, given the nature of the assessment of the quality of that research, to a pressure for volume of publication; safe topics in research activities undertaken so that it leads to publication and has therefore had a depressing effect on originality and on taking risks which are in the nature of scientific research very important things to maintain. Is that a view?

(*Professor Newell*) I think that would be more or less true. I am worried also about the pressure to conform, that the one thing the universities ought to be doing is take risks, scientific risks, academic risks, and the pressure towards performance indicators. In the mid-1980s I wrote a paper on why the wheel was not invented and that was because the research funding councils at the time would not allow people to work on those sorts of areas. I think the same has a tendency to be true, that the research councils can be building on what is already existing rather than taking risks. This also goes along with the comment about industry in the sense that there is no performance indicator in the research assessment exercise which says the number of licence agreements that the university has, the number of, in my case, pieces of software which are sold which were developed in the institution. I am not saying that we should go that way entirely, but there should be some sort of balance which also encourages universities to transfer what they have done and also allows them to do new things.

(*Professor Barr*) There can be no doubt, I think, that a measurement of the sheer volume of output which was incorporated in the last two research assessment exercises did give an indication to the system that that was what was needed and I think partly for that reason there was a decline perhaps in standards of publication. For the forthcoming research assessment exercise the volume is not going to be requested from the universities, although I understand individual panels might ask for it. That to me does pose a bit of an issue, particularly if you are looking at very high quality research centres because with two research centres of equal status in terms of their grading, five or whatever, and of equal size, if one produces twice as many publications as the other you have to say that it is better. I think those who set up the research assessment exercise structure are very sensitive now and aware of the influence it has on how research is conducted in the university and I think there has to be a very careful eye kept on how that develops.

1027. But in a sense you are fortunate in Scotland in that the system is so much smaller that it would be possible to have a proper dialogue between representatives of the funding council meeting across the table in subject committees with individual universities and faculties to have the discussions that used to take place when the whole of the United Kingdom system was small enough to do it. Would you not want that rather than these crude mechanical assessments?

(*Professor Barr*) I do not know if we have the option, my Lord Chairman. The research assessment exercise is to be carried out on a UK base and while we might conduct these discussions to see how the money might be divided within Scotland, I do not think it helps the actual RAE grading.

1028. I was putting into your mouth the possibility that you might be even more separate, so to speak, just because it was possible, but I would also like to know whether you thought the old system was better than the present because if you do not then there is no point in going down that road?

(*Professor Barr*) I think it is rather better to be compared with a large group covering the United Kingdom.

1029. But if that is done on the basis, as I say, of crude mechanical things rather than at that dialogue across the table in which with colleagues you can be probed and you can ask them and you can say, "Well, I have got research here which is not going to mature within the next seven or eight years, but when it does come it could be very important— One thinks, for example, of a case which has been mentioned to us not once but several times of Professor Gowan's work on immunology who did not produce any material until he was absolutely sure that the main thesis was fully established and could not be overthrown. That meant there was a blank in publication for some time. Will this mechanical system not take account of this? As you said, Gowan's department in Oxford was really going to score zero.

(*Professor Barr*) Certainly one can see attractions in what you say.

(*Professor Guy*) I think we would like to have it both ways. We want to have research selectivity

[Chairman *contd.*]

because selectivity enables the best laboratories to be well funded and to be well operated so that they are competitive in international terms, but we also emphasise the importance of curiosity-led research, strategic basic research which, of course, is not well represented in exercises in which volume indicators such as volumes of publications are so important. I think there is a danger that people may particularly be thinking of three year projects and may put forward proposals on projects which are not sufficiently spacious in the way that they are cast to be truly objective; that is, that people have a fairly clear idea of the rules that are going to pertain at the point that they filed the application for the grant rather than simply having the space to spend five years or whatever in a truly blue skies environment. I suppose, coming from probably what would be regarded as a more traditional university that sees itself as a research and teaching university, we would argue that many current problems could be resolved by longer research contracts, better support for infrastructure but through the mechanism of research selectivity, a world in which perhaps a third to a half of the laboratories in the UK were well funded and had the space for curiosity-led research.

1030. Do you think that will happen by the natural process of sensible people deciding these things or will it have to be taken externally to the universities by the funding council?

(*Professor Guy*) I suppose I would like to think the former but I expect the latter would be necessary. I think all universities wish to have well found laboratories, but in the zero sum game a decision has to be made about measuring quality, about selectivity, about which laboratories—not simply in terms of the university but in terms of the United Kingdom—that the United Kingdom wishes to support and maintain on a long-term or at the very least a medium-term basis in order that better quality science, deeper and more fundamental science, can be conducted. Certainly that is something that industry is not able to do because industry has relatively short-term objectives, they have shareholders, they have commercial interests which they have to maintain.

Lord Phillips of Ellesmere] I think, my Lord Chairman, in referring back, as you have done, to the system as it used to pertain we need to remember that up, say, until ten years ago when the system began to be changed the favourite Treasury argument about the way in which universities were funded with block grants to do research was that they represented perhaps the largest black hole in the economy; nobody knew what happened to the money. No doubt people could argue about how opaque that situation actually was and they would no doubt argue that, as I might, the products of that system were really very often spectacularly good. Nevertheless, I myself see little possibility of going back to a system in which there is not some sort of assessment of what the research activity in universities is. I think we are at the third or fourth round of research assessment exercises coming up. I think that manifests that it has not yet reached an ideal state and that there needs to be constructive debate from the universities and the funding councils about how some of the manifest disadvantages of the present system might be avoided.

Chairman

1031. Perhaps some sensible university might establish a little research unit to examine methods by which the research assessment is carried out and make proposals for better ones. I am not joking in this matter because universities are places where these things should be thought about.

(*Professor Newell*) I agree, my Lord Chairman, and I think what has happened is the universities have tried to play the system and that it has been forgotten that you change anything you measure and it is the same with the research assessment exercise and rather than put our efforts or some of us put our efforts into saying what is an appropriate system, we have said, "Well, here is a system, we will try and maximise its benefits to us" and that I think is our fault. I take your suggestion seriously. I think it would be an important add-on to the debate.

(*Professor McIntosh*) My Lord Chairman, there is a certain level of discussion of the nature to which you referred in that the Scottish Higher Education Funding Council does have a group which goes under the name of the Chief Executive's Research Advisory Group, and this group meets with Professor John Sizer and others of the funding council. I happen to be a member of that group. It is not a decision making group; it is strictly an advisory group, but it does have some opportunity of flagging certain of the issues and problems that we see emerging. I have had the opportunity of having input into that group to represent the situation as perceived in the new university sector which, I may say, is coming up to the second research assessment exercise and the particular issues therein.

1032. That is, if I can so term it, the funding council's in-house advisory group. I was suggesting that the universities themselves, who are closer to the coalface, might have some views themselves which they would want to put forward on this. Do you have in COSHEP relations directly with the funding councils where issues of this kind can be discussed?

(*Professor Newell*) Yes.

(*Professor Barr*) There are periodic meetings?

1033. It would be worthwhile the universities informing themselves very clearly and having a prepared position and some alternative solutions.

(*Professor Newell*) My Lord Chairman, I am on COSHEP's research committee so I will take that back to the research committee and suggest that as a way forward.

1034. It is entirely up to you.

(*Professor Chapman*) In relation to your original question, I would like to make the point that the pressure on academics to complete the period of PhD training within three years, which is a rather short period, does in itself put pressure on the kind of projects which one can find for PhD students. In this sense originality does suffer and academics cannot take too many risks with the kind of projects which they choose for their PhD students.

1035. Do you find that?

[Chairman *contd.*]

(*Professor Chapman*) Yes, I do.

1036. That is a very clear answer. Thank you very much. Is that general?
(*Professor Guy*) Yes.

1037. May I move on from this point. You introduce the question of a three-year PhD, which moves us naturally to your attitudes towards the MRes. Is it desirable or not desirable, what are its advantages and disadvantages?
(*Professor McIntosh*) You will be aware from the various consultations that have taken place that there has not been wholehearted support for the concept of the MRes.

1038. I was a chemist.
(*Professor McIntosh*) Indeed. The question, however, is whether or not the MRes concept will work and if we address that question; first of all, anything can work or has a high probability of working if people believe in it. I think in that respect we are at a slight disadvantage because many of the players do not necessarily believe in the concept of the MRes. I think it is fairly well established that many people involved with PhD students recognise the need for an increased input on a more formal basis of research methodologies, etc. I think that is not in dispute even across different subject areas. In certain areas there will be a greater emphasis perhaps than in others, depending on the particular subject discipline. I think what is, however, in question is whether the MRes firstly, as an output point, will indeed be recognised by industry for what it is intended to be, and I think that will only show once the pilot has some people graduating with that qualification. Personally, I do not believe very many will graduate at that point. I think most will continue through the pilot phase and go on to PhD.

1039. So that in terms of the quantum of money available for the funding of this, the extent to which you introduce the MRes will, in fact, reduce the availability of money for the three-year research period, is that correct?
(*Professor McIntosh*) Yes. One of the things, my Lord, that I think would be something that would have to be measured in the pilot scheme will be, first of all, the completion rates and the completion timescales because my concern would be that at the end there will be an expectation of a PhD being a PhD as was, but if part of that programme, which, as my colleague has indicated, has not been extended in total duration, is taken up with another part which has a particular output or evaluation point after one year, then there is a condensation of the period available for research in a more traditional way. I believe that a number of things need to be very closely evaluated as a result of the pilot exercise.

1040. It has been common practice, and I introduced this in my own department in Leeds in the 1950s, to have postgraduate courses for all postgraduate students and adding no more time to the length of the PhD in much the same way as the Americans had done for years. That is where I learnt it. Would you prefer that kind of arrangement to extending the MRes with a whole year allocated to it and nothing else?
(*Professor McIntosh*) My Lord Chairman, the approach that we prefer, and we have implemented, is to have a programme of research training for all PhD students. It is a mixture of, let us call it, formal presentation but also units which are learning contracts. It is both generic and also specific to subject areas, but it is not presented as a six-month condensed programme. It is embedded and integrated with the research itself which I think is a very important feature of the whole process.

1041. You can have also at the end of the first year a careful assessment of the student and the decision taken by him as to whether he wishes to go further ahead with the PhD but what you have given him is a qualification that would be useful for industry or whatever in some subjects.
(*Professor McIntosh*) Indeed, my Lord Chairman. The pattern employed within many universities is to have the opportunity for an evaluation of the student's progress and the research achievements to allow them to exit with a Masters degree. The MRes, in my opinion, and it is a personal opinion, is only a confusion.

Lord Phillips of Ellesmere

1042. Many would argue that the MSc escape route is the route of failure, whereas the MRes is an objective in itself which people might achieve and then go away and proudly claim that they had an MRes which was useful to them.
(*Professor Newell*) But you could do that, I suspect, without the necessity of having it in such a formal way.

Chairman

1043. But these arguments all point to the desirability of having a pilot scheme or several pilot schemes, do they not, and then other employers, other than universities, will make their judgment upon the utility? (*Professor McIntosh*) Indeed, my Lord Chairman. The critical issue will be the appropriate evaluation of the pilot scheme against criteria which are well established.

1044. Some of the decisions of research councils on these MRes courses have been taken. Are any of your universities the happy recipients?
(*Professor Guy*) Yes, my Lord Chairman.

1045. For how many studentships?
(*Professor Guy*) Three or four.

1046. In what field?
(*Professor Guy*) I think psychology is one. One point that has not been made is the change in the undergraduate profile in science, the introduction of the MSci, which is a five-year course in Scotland and four year course in England. There are some difficulties of perceiving how this is going to weld together.

1047. I wanted to come to this under the general heading of the impact of these changes on undergraduate courses, given the fact that it is quite evident that a significant proportion of those now being educated to first degree level in science,

[Chairman *contd.*]

engineering and technology—I am leaving out medicine deliberately because we have chosen not to be in competition with Lord Walton's parallel enquiry into the medical field but also because medicine is rather different in that in clinical medicine at any rate you always have a fall-back position of employment as a doctor. Returning to science, engineering and technology generally, it is quite evident that as the numbers of students increase in the universities that there will be many of these people who will not find employment in which their skills as scientists, engineers and technologists will be the main source of their income. It is to everyone's advantage, it seems to me, that we have more people in the workforce, whatever they are doing, who have an understanding of what science, engineering and technology contribute. After all, if you can run countries on the basis of history and classics, which is fairly common, it can also be done by this means, then the undergraduate courses have to think of the undergraduate course being for some students broad liberal education through science and that may possibly mean that with undergraduate courses there should be pauses at particular points, in the case of individual students, to ask them to make decisions under guidance as to whether they are going to go on to a full undergraduate course, leading ultimately to becoming a chartered engineer, physicist, or whatever may be the case. I think all these postgraduate changes will have their impact on the undergraduate courses and that possibly the government should have thought of this as well as the MRes before pushing it because it is only one part of a highly interactive system. Would you agree with that?

(*Professor Barr*) Yes.

(*Professor Guy*) In the arts and humanities the humanities research board one plus three scheme has actually been rather successful thus far. It may be the case that this policy, as it were, might be a science policy as opposed to a general policy for research in all subjects. The ESRC has also had a successful scheme of one year training courses which have in fact been successful both in themselves in teaching generic social science skills and also as an exit point for people who, it emerges empirically over the course of the year, were not well suited to the PhD programme. My previous remark should be understood as applying to science as opposed to the whole of the academic spectrum.

(*Professor Newell*) I think it is one area where Scotland does have its advantages because there is a much greater emphasis on inter-disciplinary courses in Scotland and faculty entry in the first year, so that I think Scotland is more able to produce graduates like this and I think it is also more able to produce inter-disciplinary researchers, if we are talking about research, than is the case in England because of the structure of the degree programmes.

1048. You do realise that the cost of producing graduates per annum is that much greater in Scotland than in England because of the one-year extension in the length of the course. It has always been thus.

(*Professor Newell*) Yes, it depends whether one society thinks that it is important to pay for that wider education.

1049. But it does, of course, leave you also with the advantage that you defer the critical decision of choice to the more mature age for the entrant.

(*Professor Newell*) That we find a great advantage. I moved up from England 15 years ago and it was only a few years into my career in Scotland that I realised the great advantages of students able to make a change in their career path.

Lord Phillips of Ellesmere

1050. Could I comment on two points there, the question of MSci was mentioned by Professor Guy, the four year course in England and the five year course in Scotland. I well remember that that was at the time represented at least to the Secretary of State for Education in England as a change in, say, the physics course, according to which 25 per cent, say, of physicists embarking on the course would actually go on to the fourth year and the others would stop at the third year. I think it has gone into a four year course for everybody and that is the sort of thing that the Government remembers. It is not the case that Government did not think about these other alternatives. I think they were sold a bill of goods on the MSci which has not been lived up to in time. The other point that I would like to make is on inter-disciplinarity, and it is only a comment. It is one of the areas in which the research assessment exercise conspicuously fails.

(*Professor Newell*) I agree entirely.

(*Professor Chapman*) My Lord, I would not like you to gain the impression that all MSci courses in Scotland will be of five years' duration. Many in physics will be of four years' duration.

Lord Howie of Troon] Could somebody tell me the difference between an MSci and an MSc?

Chairman

1051. Yes, there is an "i" in the former!

(*Professor Barr*) It is a first degree is the answer.

1052. All this in a sense grew out of what began in 1978, of the four-year enhanced engineering courses and then the fashion grew to be generally very valuable. Like all things, they have had their own momentum and proliferated, I think, beyond the bounds of reason in many ways. As far as women in science are concerned, I think we already have a lot of evidence on that and we have just had some further representation from the University of Edinburgh, but I do not want to be in dereliction of my duty and ask you, therefore, whether there are any special points which you want to draw to our attention which you think we may not have already received?

(*Professor Newell*) I have been looking at this in particular in relation to computer science and it is appalling that in 1979, 24 per cent of undergraduates were girls and in 1986 it was down to 14 per cent and was still at that level in 1992. It is interesting to note that this fall coincided with the introduction of computers into schools. I make this point because I

[Chairman *contd.*]

think that one of the problems might be that it is a cultural attitude and I am conscious that we only have one lady amongst us today. I think it might be partially because the way in which science is portrayed appeals to those things which boys tend to like doing. In computer terms it was shooting people and most of the computer games which were introduced in the early days were like that. It is not entirely a gender issue; it is an issue of types of personality, it seems to me there is a substantial gender correlation with type of personality and so we ought not to consider it solely as a gender issue but an issue of how we make science and technology important and interesting to that section of the community who are more interested in communicating with other human beings than playing with toys. That perhaps is putting it in an extreme form. I have so put it to make the point more clearly.

1053. Have you done a simple analysis of dividing those boys and girls, whom you so obviously differentiated, by the kind of school from which they have come? In other words, whether it is co-educational or single sex?

(*Professor Newell*) We were talking about this earlier this morning and within single sex schools there can be a tendency for girls to move into science in the way they do not in co-educational schools simply because they are elbowed out by the boys, particularly if you have not got sufficient equipment and so on, and the gender stereotypes I suspect can be more pronounced in a co-educational school. I believe the solution is a solution that you suggested earlier and that is that we ought actually to be looking at how we can show science to be of interest to a broader range of personality than in the past and perhaps this is an area again for university research.

Lord Phillips of Ellesmere

1054. I am very interested to hear this point of Professor Newell's because I am aware of some early work but I am not aware of any extension of it that suggested that people with so-called convergent personalities tend to the physical sciences; these are the sorts of people who if they are asked, "What you will do with a brick?", say that they would build a wall with it, whereas people with divergent personalities tend to go for the biological sciences and the arts subjects. I have not heard of a more recent analysis of that. It does seem to me a very interesting point.

(*Professor Newell*) I am doing this analysis myself in terms of our own undergraduate courses in computer science in an attempt to change this balance. I think the same is true of research. It is particularly heartening that inter-disciplinary research again can attract a broader range of personalities than in the past. With the greatest respect, the female personality has an awful lot to offer to science which we are ignoring at the moment.

Chairman

1055. Perhaps we ought to touch on the final point which is the connection of the universities and industry, particularly in relation to the contract research group. Many of them are going to go there whether they like it or not. I notice in your submission you almost suggested this might be a self-rectifying situation. In the meantime ought not something to be done and, if so, what, to try and help those staff who are in these categories to understand the importance of going into industry and not regarding it as a step downwards in terms of social esteem or whatever? Have you any observations upon that general problem?

(*Professor Newell*) I think we actually do a lot more than might be thought in terms of linking with industry. I made the point earlier about the research assessment exercise stopping this happening. There are ways in which we can improve the situation, but I am concerned that if we increase our detailed links with industry then there is a danger of babies and bath waters and speculative research going out of the window. I think, though, that universities can provide new applications ideas and I am conscious that none of the things that I have done which have ended up in industry would have been funded by industry when I started them because they had a long time period. We have this danger in that if we say we will only do things which industry wants us to do then we shall always be working at a very short timescale.

1056. I do not think industry wants you to do that.

(*Professor Newell*) No, but I think there is government pressure towards technology transfer and that is not understanding what industry really wants us to do.

(*Professor McIntosh*) My Lord Chairman, one of the dimensions which I perceive as being a Scottish one in this is that a considerable part of the industry in Scotland is centred on small to medium-sized enterprises. I think that that potentially gives a different dimension. The large organisation will have its own research and development sections and departments, but smaller companies do not have that, although they have the requirement which is periodic and, therefore, there can be a level of interaction there when universities can play a very significant part in technology transfer. My colleague mentioned earlier industrial interaction at the undergraduate level which I would thoroughly endorse. There are difficulties in that in the sense that the people we want to get to go to and from industry are also the people that we do not wish to lose. They are often the people who are very central within the organisation, the very active researcher or the excellent teacher, and in industry the person we want cannot be released, they are too important to the operation. We have that continual problem and tension.

1057. So does that mean you deplore the cessation of the LINK scheme?

(*Professor McIntosh*) I think any form of support to enable that interchange if it bridges the financial problems is to be thoroughly supported. We do obviously tend to try and get people on secondments

[Chairman *contd.*]

to industry and bring people in to keep that interaction going. There are a lot of spin-offs from that. It does also bring the researchers into contact with industrialists. Therefore, they are fully aware of the possibilities and particular career developments perhaps in industry. There was one issue I should have raised earlier and that is that it is a practice in some institutions to have all PhD students associated with an external collaborating establishment. My own experience shows a fairly high proportion of PhD graduates finished in employment with that collaborating establishment.

1058. It is like a sponsorship, is it not?

(*Professor McIntosh*) It does not need to be as firm, my Lord Chairman.

Lord Phillips of Ellesmere

1059. Could I ask whether any of you have involvement in the teaching company scheme?

(*Professor Barr*) Yes.

(*Professor Chapman*) Yes.

(*Professor McIntosh*) Yes.

1060. Do you find that particularly useful for small to medium enterprises?

(*Professor McIntosh*) I would confirm yes. It has been effective in that way.

Lord Haskel

1061. Has it been effective in getting young scientists into these companies?

(*Professor McIntosh*) Yes, in small ways. The main advantage has been the resulting technology transfer.

Chairman

1062. Which way, both ways?

(*Professor McIntosh*) Both ways, and products.

(*Professor Newell*) I think it is also advantageous compared to the LINK scheme in that LINK rules are making it very difficult for small enterprises to collaborate with universities. I think that is a major problem with the LINK system. In case your noble colleagues do not know this, the LINK rules allow only 50 per cent of the total project to be funded. The universities must have 100 per cent funding and, therefore, if you have got a small company and a large research group in a university then the company has ten or 20 per cent funding and that makes it very difficult. That is one of the advantages a teaching company has, that it does not have those rules.

(*Professor Barr*) Perhaps I may give my reflections on this issue because I am actually nearing retirement and I remember this business being discussed for many many years and I still think that we are not near a solution. I think there is agreement amongst most people that the relationship between industry and the academia in this country is not as good as it might be. It is not as good as we imagine it to be in the USA or perhaps Germany and France. It seems we have approached the subject piecemeal. A number of little efforts have been made, the LINK scheme, the teaching company scheme, DTI had a senior scientists in industry scheme. We are good at research in this country. There ought to be someone or some group who could come up with the proper answer to a scheme for developing this interaction properly. I am thinking of things like a secondment from industry and from academia into the Department of Education and the Department of Trade and Industry and these departments coming together having some sort of concentrated effort at solving this problem.

1063. Is there not a really important finance and cultural difference between industry and the United Kingdom and other places evidenced by the simple fact that if you look at the actual profits of companies and then how they are allocated, far more is allocated here as dividends to shareholders as against money put for research and development than in other countries?

(*Professor Barr*) I understand that is the case, yes, and that must militate against what we are discussing.

1064. So there is the problem there of educating industry, whether SME, small/medium enterprises, or very large firms, to go down the other route if they want to compete?

(*Professor Barr*) It is unlikely we will change their framework, of course. Whether we are doing the best that can be done within that framework is the question.

1065. It is to their advantage so to do.

(*Professor McIntosh*) I would certainly concur with that view. The lack of investment in that area is significant. It does lead to a short-termism that dictates against the interchange that we would wish.

(*Professor Newell*) That, my Lord Chairman, is why COSHEP suggested that academic scientists, engineers should be appointed more to the boards of companies than in the past. The universities have industrialists on their boards. There is not a great deal of reciprocation and that might be a way to get industry to understand the ways in which they can collaborate and question the size of dividends and so on.

1066. Creative anarchists on the board of industry; is that what you are looking for?

(*Professor Chapman*) My Lord Chairman, I should perhaps say that having spent just over a year in my new institution, Paisley, my impression is that there the links between the university and industry are very strong largely due to what is called the Corporate Partners Programme which brings industry on board. There are many events which are organised around the Corporate Partners Scheme. They have access, for example, to the university library.

1067. Do you charge for that?

(*Professor Chapman*) They pay an annual fee to join the programme.

1068. Membership gives it to them?

(*Professor Chapman*) Yes.

1069. They are also aware of the facilities which the university can offer in relation to solving industry's problems and they make use of these facilities for which they are charged.

[Chairman *contd.*]

1070. I think quite a number of other universities have been the focus of industrial funds, have they not?

(*Professor Chapman*) Yes.

1071. What is the former university you were at?

(*Professor Chapman*) University of Manchester.

1072. I think now we have really exhausted the time. I do want you to feel that you have said all that you want to. Is there any other point that you would like to bring to our attention which we have not already covered?

(*Professor Barr*) I have nothing left, my Lord Chairman.

(*Professor McIntosh*) The main part of the discussion has been to do with the careers of researchers and I would just wish to reiterate that these researchers are very often young members of academic staff who have a mixed role.

1073. Yes, you made that point earlier.

(*Professor McIntosh*) Thank you.

1074. Thank you all very much for coming.

(*Professor Barr*) On behalf of my colleagues and COSHEP, can I thank you, my Lord Chairman, and the Committee for listening to us and for your most interesting discussion.

Chairman] Thank you very much indeed.

TUESDAY 2 MAY 1995

Present:

Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Craig of Radley, L.	Renwick, L.
Dixon-Smith, L.	Platt of Writtle, B.
Haskel, L.	Selborne, E.
Howie of Troon, L.	

Memorandum by Council of Science and Technology Institutes

The White Paper on Science and Technology (*Realising our Potential,* Cm 2250, HMSO London, May 1993) argued that the aims of publicly-funded research should be the creation of wealth and the improvement of the quality of life.

In order to sharpen the focus of research establishments on these important objectives, substantial effort is being directed at, for example, Technology Foresight.

But effective R&D depends on people and an equivalent effort is required to ensure that adequately trained and highly motivated people are available, in sufficient numbers and of the necessary quality.

The questions raised by the Committee have identified the main factors that will determine whether this is so or not.

CSTI members believe that there are serious inadequacies in the present career structure that may render a scientific career unattractive, especially to women, with too great a dependence on short-term contracts and all the insecurity that this entails, and an unsatisfactory age structure which portends considerable problems in the future.

There is a special difficulty with Clinical Scientists, whose role is poorly understood, and a need to relate numbers trained to career opportunities.

But several of the questions cannot currently be answered with confidence, due to lack of information or a failure to collate it in the form required. The professional institutes represented by CSTI could play a useful role in filling these gaps.

As the Royal Society have pointed out, "policy on career structure is central to the well-being of UK science and technology".

The Sub-Committee's present enquiry is thus timely and could stimulate a comprehensive study of present career structures and the need for change. Career prospects are crucial to the professional scientists that CSTI represents and a network of membership already exists to explore both problems and needs.

CSTI is well-placed to co-ordinate such an assessment of the career prospects of scientists and technologists (and how they are perceived) and to make recommendations for improvement.

Memorandum by the Royal Society of Chemistry

Before commenting on the questions given in the Call for Evidence we provided in Table 1 (*not printed*), some information on current staff employed in "old" chemistry departments. Since 1980–81 there has been a steady reduction in fully funded staff, although since 1987–88 the total numbers of fully funded plus full-time partly funded staff has remained approximately constant.

The only comment we wish to make on the age distribution of academic chemistry staff is that it is bimodal unlike the unimodal distribution for some other sciences. Age distribution and projection for future requirements are well covered by the Institute of Manpower Studies Report No. 1646 (The Recruitment of PhD Science Graduates—a Survey of Demand Trends, by H Connor et al.). We make the comment, however, that since the projections for staff required in the future relate to anticipated student members they can only provide an indication of the number of staff required for teaching. It is far more difficult to anticipate the number of university staff to do research or indeed to anticipate the breath of skills staff will require for teaching purposes.

On questions 1 to 7 our comments are given below.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

We see the problems as being mainly associated with the need to carry out the traditional duties of academic chemists (teaching, motivating, enthusing well qualified undergraduates and postgraduates) while coping with the ever increasing demands of bureaucracy, teaching remedial/infill courses to poorly qualified university entrants, search for funds, requirement to better understand industry needs, wealth creation, competition between universities etc. All this is being required with fewer full time staff and increasing student/staff ratios.

The traditional advantages for academic chemists of academic freedom are declining markedly, particularly with teaching and research assessment exercises.

2. *What are the advantages and disadavantages of the growth in short term research contracts?*

The advantages are that universities can use good quality researchers to bring in and carry out specific research contracts with little responsibility to those workers when the contracts end.

Short term contracts are equally attractive to industry in that good staff can be engaged through university departments, at relatively low cost and encourage the view in some companies that outsourcing strategic research (and some nearer term) research to universities is a better option than maintaining inhouse facilities. It is possible to argue that the strategy being employed by universities is damaging in the long term to career prospects of chemists, not only those in universities, but also of all chemists. Artificially low wage structures for bench chemists are being created. Further, since university chemistry departments rarely, if ever, change the level of overheads to fully furnish and equip laboratories to modern industrial standards, the procedure can be considered as detrimental to the whole science base.

3. *How do you expect the situation to change in the next decade?*

The academic career market for chemists lives through boom and bust periods. During boom periods such as in the 1960's, some appointees may be of modest quality, particularly if industrial demand is high.

On the issue of quality of new staff, it is possible that we may see some return to a culture of corporate industrial laboratories willing to pay high salaries to the very best chemists. This may draw some of the big name researchers away from universities.

However, overall the chemical industries with rationalisation and mergers are likely to continue to reduce staffing levels, including those of researchers. Current manpower projections, based on a large replacement staff inflow, may be encouraging to prospective academic chemists, but if industrial demand stays lower, it is impossible to ignore the question of whether there are too many university chemistry departments carrying out research.

We draw attention to two of a number of objectives of the American Chemical Society, following the deliberations of a panel of senior American industrial and academic chemists.

- Two optimise government—university—industry alliances, to *do more with less* across the chemical research enterprise;
- To reduce the number of PhD granting chemistry and chemical engineering departments and to ensure adequate support for those that remain.

We note too that particularly since 1990–91 many more chemistry graduates are entering postgraduate education than any other form of employment (Table 2) in marked contrast to the general graduate population. Also, a high proportion of these chemists continue their postgraduate education still in chemistry. These figures require closer examination to determine whether or not this trend will mean supply will exceed demand for chemists with higher degrees.

Although at the moment we suspect there is little evidence we question whether over the next ten years we may see a decreasing number of overseas students. For example, we know that places like Singapore have developed a well regarded science training base, which is attractive to some of our multinational companies. Again, this may cause reductions in number/size of our chemistry departments.

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector?*

The four main outlets for chemists, i.e. permanent positions in universities, posts in schools and further education, industries, other businesses and financial sectors are all at the whim of the market place.

The suitability of contract workers for many possible forms of employment may depend on the breath of their training and experience prior to contract work, and the nature of the contract work. Retraining of some contract workers may be required particularly those who have spent some years in a very narrow specialisation.

5. *What should be done to improve the mobility of scientists between academia and industry*

To overcome inertia and fears that moves may be detrimental to career prospects significant financial rewards and employment guarantees are required.

6. *How do you expect the situation concerning women in science and engineering to change in the next decade?*

The Royal Society of Chemistry has a Women Chemists Committee who have done much to promote careers in chemistry for women. Some of their concerns centre on the adverse effects of career breaks for women in research. The Society has tried to revise this by changing the age limits for some of the rewards to allow for career breaks.

There are many other initiatives.

For the dedicated specialist the requirement for continuity in research will always make it difficult for anyone who anticipates taking career breaks for whatever reason.

However, with changing employment practices and with requirement for more breath in training and more general skills there does seem to be significant opportunities for women scientists in academia. It is perhaps a question of looking for the opportunity that may arise.

We would again draw attention to differences in chemistry, biology and physics for women. In 1992–93 the figures are for percentage of women in each discipline gaining degrees:

Discipline	*First degree*	*Higher degree*
Chemistry	36	27
Physics	17	15
Biology	57	43

Further, the proportion of women doing chemistry has been increasing year by year.

For chemistry, there appears to be an adequate base for encouraging more women into academic careers.

7. *The M.Res. qualification*

The Royal Society of Chemistry's position was made plain in our submission (copy enclosed (*not printed*)) to OST.

Letter from the Geological Society

The Geological Society is grateful for the opportunity to contribute to the enquiry into academic careers for graduate scientists. We offer below our detailed responses to your specific questions:

(1) With regard to current career structures, we perceive three particular problems:

- (i) there is a growing tension between the ever increasing demands of teaching and research. There is rarely a symbiotic relationship between these two key career activities.
- (ii) for too many permanent staff, there is an absence of opportunities for sideway transfer into other academic institutions or short term placements in industry, leading to lifelong careers in a single academic department;
- (iii) for short term contract staff, there are difficulties of winning research grants and research studentship awards in their own right because of their temporary status, and longer term career prospects are poor, as discussed below.

(2) The growth in short term research contracts has often been at the expense of longer term strategic or pure research programmes—too often a case of scientific research activity following the available money. There are other external pressures on academic scientists that similarly encourage moves into research programmes with short term objectives. It is safe to assume that whatever the benefits in terms of closer links with industry and increased wealth creation, these tendencies will, over a period of time, adversely affect the rate at which major scientific advances are achieved in UK universities.

Advantages of the growth in short term research contracts are the increased job opportunities presented for bright young academics and the beneficial effects these staff have on the academic environments of the departments in which they work. However, there are too few longer term opportunities in academia for such staff: many are forced to take other types of employment at the termination of research contracts and therefore represent a lost resource to academia. A particular problem is that young staff appointed to work under the terms of research contracts often have, or develop, narrowly specialised research skills that do not equip them well for permanent academic careers as lecturing staff.

The current very adverse age profiles and high ratios of senior to junior staff in many departments will be ameliorated by an increased rate of retirements, including early retirements. A continued drive for greater productivity through higher student staff ratios will, however, limit the number of new career opportunities presented by the higher retirement rate and, as stated above, such opportunities as arise will not always be open to the specialised research staff currently employed on short term contracts.

(4) We have no detailed information to hand on the destinations of contract research staff who have worked in university geoscience departments.

(5) Professional bodies should be pressed to explore new and effective schemes for two-way transfers between academia and industry. Such transfers would, on the one hand, help to inject the results of new research into industrial practice and, on the other, introduce a greater degree of commercial expertise and awareness into the work of academic establishments. Financial inducements by government to assist with innovative schemes involving staff transfer or secondment would assist this process.

(6) There has been a steady increase in the number of women studying geology and entering the geological profession over the past decade. We expect this trend to continue. The key to making scientific careers more attractive to women is to make science a much more attractive subject for female students at school level, and this problem needs addressing through the content of National Curriculum: Science, post-16 science syllabuses and new approaches to teaching science.

(7) The Geological Society remains to be convinced that the new MRes will come to be widely accepted as a useful Masters qualification in its own right or as a satisfactory alternative route into PhD programmes of study. Meanwhile, the reduction of Research Council funding for existing advanced course studentships and the research studentships in order to accommodate the new scheme will adversely affect the numbers of graduate students on advanced vocational courses and undertaking research training, and these developments are deplored.

We look forward to receiving a report of the findings and recommendations of the Sub-Committee in due course.

Examination of Witnesses

PROFESSOR SIR COLIN SPEDDING, Chairman of the CSTI, PROFESSOR E W ABEL, President Elect of the Royal Society of Chemistry, PROFESSOR J S CLIFTON, Chairman of the CSTI's Health Care Scientific Advisory Committee, Council of Science and Technology Institutes, called in the examined.

Chairman

1075. Good morning, Sir Colin, Professor Abel and Professor Clifton; thank you for coming. We have, of course, got your several papers under the CSTI imprint and all the Committee have, I am sure, read them very carefully. I wonder whether you wish to make an introductory statement yourselves because you are perfectly free to do so, either one speaking for all or, since you have a chemist on your right and a physicist on your left and I think you are broadly described as an agriculturalist, Sir Colin, you may have different slants which you wish to bring out. Then, if it suits you, we will go into the regular questioning.

(*Professor Sir Colin Spedding*) Thank you, my Lord Chairman. I would like to make some introductory remarks, one of which is that we do not see ourselves as being here to represent our separate facets but trying to speak on behalf of CSTI. Although we do come from different sectors, we are going to try and leave that aside because you have heard from those institutions for the most part separately anyway. What I would like to say is that the Council of Science and Technology Institutes has a federal structure so it does not actually represent all the constituent members of which there are nine, the Royal Society of Chemistry, the Institute of Biology and the Royal Society of Physics being the largest by far. It exists to bring those bodies together to liaise and establish where there is common ground and to speak and act for and on behalf of them where that is appropriate and quite often it is not for one reason or another. As you will be aware, my Lord Chairman, even the chemists and physicists sometimes disagree, puzzling as that may seem. Therefore we have to be very careful when we are asked a question to make sure we are answering for CSTI rather than those individual bodies which are perfectly capable of answering for themselves. There are some areas where we can speak for all of them. There are some occasions when we do all agree, an example of that is in relation to the MRes, when we are all combined in our opposition to it. There are also occasions when we agree because of our diversity. We can represent a more comprehensive view of something. An example of that would be two of our current studies which are on continuing professional development where we have different experiences in different sectors, but there is room for a picture of what it all adds up to; and the topic within your remit, women in science, where again we think we can create a better picture of the whole because we have diverse experiences.

1076. Professor Abel?

(*Professor Abel*) The Royal Society of Chemistry has submitted a paper in the call for evidence for this Committee. You have that and I have nothing specific to add to that on behalf of the Society at the moment.

(*Professor Clifton*) My Lord, I act as the Chairman of the CSTI Health Care Scientific Advisory Committee which has an overview of clinical science in health care and you have some evidence which was submitted to you by one of our colleagues, Dr Greenaway, from the Department of Health and I will speak further to that if you wish me to do so.

1077. I wonder if I could start off by asking you a question which arises on the CSTI's notes about half way down the first page. You say: "There is a special difficulty with clinical scientists, whose role is poorly

[Chairman *contd.*]

understood, and a need to relate the numbers trained to career opportunities." That was a little opaque to my mind and also I thought the clinical research scientists had an advantage over the rest of contract researchers in that if they were medically qualified they had a good fallback position. Is that so?

(*Professor Sir Colin Spedding*) It was designed to be expanded upon and Professor Clifton is the man to do it.

(*Professor Clifton*) Yes my Lord. I think first one must define two categories of clinical scientist. The reference you make was in the paper by Dr Greenaway and Dr Greenaway was there concerning himself exclusively with those clinical scientists who are employed in the National Health Service, in other words they have contracts of employment within the hospitals. In parallel with that you have another group of clinical scientists who are those scientists who work in, if you like, medical academia but who are not medically qualified; in other words graduate scientists who may work in the department of surgery or medicine but are not medically qualified. They have a particular career problem because they do not have the fallback situation which you related to which concerns the medically qualified scientist working in research who can undertake research as part of their career pattern and they are able to move in and out of academia to their advantage. If you take a graduate scientist who is not medically qualified and put him or her into that environment then his or her career is very very limited because they become very specialist in a particular area because they will have been taken on board for a research contract in a particular area of research. They would become very expert in that but very narrow and with no real career prospect in front of them. The other group, which Dr Greenaway was referring to in his report when he referred to career prospects and manpower planning, is the group that is within the NHS. This is the Clinical Scientist as defined under the Whitley Council regulations. Now this person has a career prospect. It is a profession which has a series of grades which originally used to be parallel to the old civil service scientific grades. The difficulty we now face is that with the new NHS management, as we know it, with the requirements for the internal market and so on, managers do not clearly understand the role of clinical scientists. They are only a very small cohort, something like 2,000 of them in total in the NHS, spread across 11 different disciplines and the net result of that is, on the one hand, management does not understand the management of innovation which is really what clinical scientists in health care are about; they are about developing the Service itself, what we call implicit research. Implicit research was referred to in the recent Culyer Report but the Culyer Report did not define how it should be funded. It referred to the importance of it but it ducks the issue of how it should be funded. Managers do not understand the management of innovation. Conversely because of the internal market and their requirement to essentially prefer the lowest price contracts, those larger hospital institutions which have a cohort of clinical scientists inevitably, because those clinical scientists have always been involved to a certain extent in research and development, have a higher cost per unit examination than the district general hospital which is not involved in this sort of development of the Service. Therefore the manager has a problem; in order to get his budget he must have a contract which is at a low price. If he does that one of the areas which he sees as being expendable is the clinical scientist and we are seeing pressure to reduce the number of clinical scientists.

1078. Thank you very much indeed. That clarifies the position, some of which lies outside our terms of reference which is academic careers for graduate scientists, the emphasis on the academic. Professor Abel, I notice in the RSC's submission you said there was a higher proportion of graduates in chemistry than in other subjects going on to postgraduate work. Why is this so and does this mean the problem is worse in chemistry than it is in other comparable disciplines?

(*Professor Abel*) Worse or better, my Lord, whichever way you look this. I think there are two reasons for this. The first is that people with a first degree are seeing there may not be the opportunities at the particular time they would like the positions so they take postgraduate training as a thing to do. There is also the argument that the jobs market is becoming tougher and tougher. Chemists are seeing that in order to get the sort of position they would want in academia or even industry now they have to have postgraduate degrees and this is being pushed quite strongly by the pharmaceutical companies.

1079. To a certain extent you are slightly atypical but not widely divergent from the others?

(*Professor Abel*) Not hugely. I think, as you say, we are a little bit out of line with the others but I think it is a scientific trend rather than a chemical trend.

1080. You also say in your submission somewhere there has been no great increase in contract research over the years as if chemists had already had a lot of this to begin with and it is a relatively recent development in other disciplines. Have we got that right?

(*Professor Abel*) I think it is increasing in chemistry and I think any increase is a serious trend so I think there should be a judicious mixture of permanent and contract appointments. Overall in science over the last ten years, I think it is right to say that the number of contract workers in higher education has doubled and in the last 20 years has quadrupled. It is a serious trend and while chemistry is used to it we do not want it to go much further.

1081. How do you manage it in chemistry? Do you follow the practice which University College London does in ensuring that the careers of these people are carefully appraised and advice given to them?

(*Professor Abel*) I think that varies from institution to institution, my Lord. I do not think I could generalise because that becomes an institutional matter rather than a chemical matter. I think a large number of my chemical colleagues in higher education are conscious of this problem and I am in constant touch with major aspects of the chemical and pharmaceutical industry and our endeavour to ensure an interface.

1082. It is mainly at the departmental level where such advice is given?

[Chairman *contd.*]

(*Professor Abel*) Yes, I know of very little advice of that sort at institutional level and I would be interested to know how University College manages that at an institutional level, if not at a departmental level because I think the departmental level is the natural level to manage that sort of transfer.

1083. I think one of the reasons is, and perhaps you can comment on this, that there are so many institutions of that kind, that in fact they can produce bridging funds between contracts or, indeed, before a person leaves by pulling in a little money from their total contract income which is much more difficult for smaller institutions.

(*Professor Abel*) I think the advantage of size is quite right, my Lord. Smaller institutions would find creating a bunce pool of that sort extremely difficult.

1084. Could I just ask you all of you a general question. This is a situation which has developed, as you said, over the last 20 years with the quadrupling of those people in contract research. Meanwhile the academic staff in the sciences in established categories have remained fairly constant in number but ageing. Do you see any likelihood of change in this situation which will make it self-correcting in the years to come?

(*Professor Sir Colin Spedding*) I think part of the problem here, my Lord Chairman, is that CSTI may not have an answer to this. It is a different sort of problem in different subject areas and, as Professor Abel pointed out, it varies from institution to institution. The CSTI view about short-term contracts is that while it is quite easy to see the advantages and disadvantages it is a question of balance and we think the balance is too heavy and there is too great a dependence on short-term contracts at the present time.

1085. Given that is so, what can be done to correct that? Can it be corrected given the current climate of opinion about funding of higher education?

(*Professor Sir Colin Spedding*) I hope it could be corrected but the trend seems to me not to favour that. Indeed, as I see it, short-term contracts are increasing in industry as well.

1086. If that cannot be done then we will have to live with this situation; is that what you are saying?

(*Professor Sir Colin Spedding*) No. I would hope that something can be done, but I am not in a position to say what it should be. CSTI has not formulated a view about that.

1087. Do feel free to speak other than for CSTI, as an individual if you wish.

(*Professor Sir Colin Spedding*) I dare say my colleagues could do that.

Lord Dixon-Smith

1088. I can well appreciate the desire to have more people on what are called normal conventional full-time contracts. That implies, of course, that you are going to lower the overhead costs of each employee to a degree which would also imply that each pound that was currently spent on research would buy less research. Would that actually concern you?

(*Professor Sir Colin Spedding*) It is difficult to generalise across universities for this because the patterns are different. My own university experience suggested that universities were unable to charge the overheads that should properly be charged though greatly encouraged by government to do so, and no government department would actually pay the overheads they were recommending that the universities should charge. This was certainly so in agriculture and I believe in other fields as well. The universities have been greatly hampered, in my experience, in building up any such funds so that I would not see it as a full overhead being charged at the moment and then requiring more.

1089. What I am saying is if we have to start charging these overheads, assuming the volume of funding stays constant, it would imply a lower volume of research?

(*Professor Sir Colin Spedding*) Yes, that might be so, but I am not persuaded myself that it is a black-and-white issue between short-term contract research and not. There are various types of short-term contracts. You can have rolling contracts where there is some element of security built in without the loss of the flexibility. I would like to see those avenues pursued to a greater extent.

Lord Phillips of Ellesmere

1090. It is well known to some people that I deplore this use of the word "overheads". What I think university research groups must do is obtain the full costs of the research they do from whoever it is that wants to fund it. This talk of overheads simply confuses the whole issue.

(*Professor Sir Colin Spedding*) I could not agree more, my Lord, but unfortunately, as you well know, it is usually others who lay down the form in which the costs have to be postulated.

1091. I think, with respect, that it was largely the funding councils and universities that introduced this talk of overheads and it is the down side of the dual funding system.

(*Professor Sir Colin Spedding*) Yes, that is right. It is inherited from that way of thinking.

1092. Since industry says that you get all this money for which we pay taxes to support our research, therefore we should not pay the full cost of the research. That I think is something that should be addressed.

(*Professor Sir Colin Spedding*) Yes.

(*Professor Abel*) I think, my Lord, that problem has been addressed in the new research councils in that the obtaining of fuller funding is now better managed than it was previously.

Lord Phillips of Ellesmere] Since I was involved I would have to say that I thought that was a step in the right direction. Not everyone agrees. It leaves the universities and the funding council responsible for the maintenance of the premises, the equipment of the premises to some extent and the academics' salaries which are a point of great concern. I think there remains a very foggy issue here that has not been properly resolved.

Chairman

1093. It has been represented to us by others that there are great problems where there is very expensive equipment necessary for research and that the position now, after a decade or so of this new regime, is that the equipment of the universities is not, in fact, at a level generally that it should be in order to be able to carry out certain kinds of research. Is that your view and, if so, how should it be funded given that the funding council's resources for equipment is very meagre?

(*Professor Sir Colin Spedding*) There is not a CSTI view on that, of course, and the view would vary between universities. In my own experience even within a university it would vary within one department to another. There is an equal variation in their dependence on very expensive sophisticated equipment anyway.

1094. Physics and chemistry come into the category mentioned. Professor Abel?

(*Professor Abel*) I have a fairly simple view on this, my Lord Chairman. The problem can be solved by a lot more money. How it is channelled into the universities is a matter for debate. If there is not going to be more money then the only solution is concentration.

1095. Concentration of research or shared equipment?

(*Professor Abel*) Both. I think one would imply the other.

Lord Craig of Radley

1096. I wanted to go back to the original point where we were talking about clinical scientists and actually take it a bit further because in that little paragraph you talked about the need to relate numbers trained to career opportunities. This then raises the wider issue as to what sort of planning there ought to be between the number of people we train in relation to the likely career opportunities not just in the field of clinical scientists but more widely. We have had evidence of people telling us, and understandably perhaps, that there should be no limit on the number of DPhils other than the financial funds will imply. I was not quite clear whether you were actually getting at the suggestion here that there ought to be direct planning?

(*Professor Sir Colin Spedding*) I think our answers would depend on our particular standpoints here and vary from discipline to discipline. My personal answer would vary according to whether you were talking about the number of people trained or educated. You may think this is hair splitting, but the more emphasis you put on training the more the obligation perhaps to plan. For a broad education it does not seem to me the same argument applies. We were identifying a particular problem in the health care region and Professor Clifton can expand on that.

Chairman] I think Lord Howie wants to ask a question.

Lord Howie of Troon

1097. I am a little bit timorous about asking it, to tell you the truth. I am really wondering what weight we can put on your evidence as a Council. I know that sounds terrible. You say toward the bottom of your submission that several of the questions that we have asked cannot be answered with confidence and yet some of your constituent members, and indeed others, seem to have answered them. What is your problem? Are you unable to reach a consensus as a Council? What is the difficulty? Have I misunderstood that paragraph totally?

(*Professor Sir Colin Spedding*) No, I do not think so, my Lord. I think that when I read the submissions by individual members it seemed to me there was a common thread identifying lack of information. For example, it occurred in the health care submission, it also occurred in the evidence given by Sir Arnold Wolfendale, who actually volunteered to put some of that right by an exercise within the Institute of Physics. My impression was that I was identifying a broad issue where there was a lack of information as to career prospects and where graduates went at the moment, how they were used and so forth, and that one of the valuable contributions the CSTI might make would be to construct a comprehensive picture which was not just biased in one direction.

1098. You are trying to do that, I take it?

(*Professor Sir Colin Spedding*) We would like to do that. Currently, I have to say, we do not have the resources to do it.

Lord Haskel

1099. It seems to me that as the Council of Science and Technology Institute represents a variety of institutions you may be in a an ideal position to tell us whether there is much differential in the rates of pay for contract research scientists. Are there differentials between different types of science? Are there differentials between different types of contracts? Are there differentials within institutions? Does the pay vary or is it pretty well standard?

(*Professor Sir Colin Spedding*) I think, my Lord, this is a very good example of where we do not have the information and had we the resources we could put it together for a broad picture. I am not sure of the extent to which any of our constituent members actually have that information for their own discipline. My gut feeling would be that of course there are differentials. There nearly always are if you are covering medicine, veterinary science, agriculture and so on. I do not know what they are. It would be very interesting to know that.

Chairman

1100. Without that information we do have quite a considerable amount of evidence which suggests that people would be much better placed if some of these individual contracts were of longer duration on the grounds that time is wasted with the person in the final year and also in the first year and, therefore, very little value for money comes out of it and the person's capacity is not used properly. Have you got views on that which can be said to be unanimous?

[Chairman *contd.*]

(*Professor Sir Colin Spedding*) Yes. I think we are all agreed upon those disadvantages. We might disagree about what balancing advantages there are in the flexibility inherent in a short-term contract situation. We certainly would all share the very concerns you have expressed that the situation is actually an inefficient one because of the proportion of a contract which the occupant has got to spend thinking about where he goes next if it is not renewed or where he can bring in the money to get it renewed. There does seem to me to be a marked inefficiency in there. What concerns us to an even greater extent in a way is the effect on the morale of the scientists involved. We see scientific research making its major contribution from people who are highly motivated as well as highly qualified. It seems to me that the current dependence on the short-term contract situation actually discourages motivation and it may even discourage people wishing to participate.

1101. So you would say that the scheme is inadequate even on the grounds of efficiency?

(*Professor Sir Colin Spedding*) I would, yes, and I think there would be general agreement about that.

Lord Craig of Radley

1102. Not necessarily, my Lord Chairman, from all those who are providing the funds because presumably if they are providing the funds they believe they are doing it to the best advantage of their particular interest.

(*Professor Sir Colin Spedding*) It does not follow that they are right. It is a question of how good they are at assessing even their own interest because we have all of us, presumably, seen contracts where the key chap disappears part way through it because he has been offered something else and he cannot afford to turn it down. It is not in the interests of a funding body to have a contract shuffled off on to some replacement for the last year or something of that kind.

Lord Dixon-Smith

1103. Surely that is what I would call an occupational risk of any human organisation and particularly good staff. I remember the great thing about good staff is that they do, if you like, attract opportunity. Is there any evidence, shall we say, of a shortage of willingness to undertake research? Are there opportunities for research which are not being taken up, if you like, because of the reluctance of researchers to operate? I can understand, shall we say, vexation with the system. What I am not sure that I have heard any evidence of yet is an unwillingness to operate in it even though they may be vexed about it.

(*Professor Sir Colin Spedding*) I do not think, my Lord, that such evidence would easily exist because you cannot ask the people who are not there.

1104. You could ask them if they are providing funding whether in fact they are getting—

(*Professor Sir Colin Spedding*) I have known of a good deal of dissatisfaction with the quality of the research funded and I would think that we ought to be concerned as to whether we are in fact attracting the right quality of people. As for the best ones actually being successful in getting continued funding, we all know that there is an inherent emphasis on track record and that sort of thing and so somebody who is reasonably well established or working in a well established group may have an advantage irrespective of the quality, and that does not attract in people who have no track record. It is one of the deficiencies, it seems to me, in looking at career structures that we take a rather mechanistic view and do not have sufficient regard, for example, to the need for innovation. If you look at the historical record, a great deal of the most innovative breakthroughs have come from people who have changed career, come from a quite different topic with no track record at all, particularly in that subject, very often with no qualifications in that subject. I would like to ask what are we doing in a career structure that would make it possible for people to come in from other fields? Their chances of getting funded would actually be remote. We would like to suggest, incidently, my Lord Chairman, that this line of thinking could be very profitably related to the needs of women because women have that very problem at the moment of how do they get back in having left and the problems of catching up. Our view would be that that difficulty could be transformed to some extent into an opportunity, an advantage, if they were encouraged to come back in with a change of subject area at that time. They could read about it whilst they were out, of course, but instead of the problem of catching up and getting back in you would cash in on the innovative power of a new mind looking at that subject.

Baroness Platt of Writtle

1105. Surely on the question of women, for somebody who has acquired expertise much the most important thing is for universities to arrange for flexible working arrangements so that they do not go out for a period and lose that expertise because enormous public and private investment has been made to enable its acquisition. I would have thought the most important thing was the opportunity for part-time work, perhaps the provision of creches and child care vouchers, or off-site working. It is much more important to have flexible working arrangements. If during that time, as you say, there is a change of career that is fine but to just throw away expertise seems to me a very bad idea.

(*Professor Sir Colin Spedding*) I am grateful, Lady Platt, for the opportunity to correct the misapprehension which I have obviously conveyed. The only point where I might disagree with you is that it is a matter of judgement as to whether that is the most important thing or not. I have no difficulty in agreeing that all you have said is important and that those arrangements should be made for women who can take advantage of them. There are also women who do drop out for a significant period and for whom continuity is a problem. It seems to me in those cases one could consider this opportunity to cash in in a different way.

Lord Dixon-Smith

1106. I entirely accept what you say about this possibility of a breakthrough as a result of somebody coming in from perhaps somewhere different for whatever reason. The difficulty with that is that it seems to me that providing that opportunity is in conflict with what I thought you were implying earlier which was the need for overall manpower planning in this particular field to make sure that the volume of people involved and actually being trained was a continuum which worked smoothly. What you are saying is that some of the most productive outcomes arise from totally unforeseeable events which is in conflict with what is implied by manpower planning.

(*Professor Sir Colin Spedding*) I would expect, my Lord, almost everything I say to be in conflict with something else I say, precisely because we are very reluctant to generalise as if some proposition were true across the field. With different institutions and different subjects, different solutions have to be contemplated for different parts of the whole system. I accept that we dropped somewhere the follow-up Professor Clifton was going to make for that specific need for manpower planning.

(*Professor Clifton*) The point that needs to be made is that that reference comes out of the paper put to you by Dr Greenaway where of course the Department of Health is very concerned about manpower planning and clinical scientists being a group of graduate scientists employed in health care. They are concerned that the manpower planning is appropriate and there are difficulties because the whole structure for the career of clinical scientists has changed in recent years and we are now recruiting what are called "Grade A" scientists. I might point out two things; firstly recruitment at that grade is on a contract basis for two to three years training in the first instance. We are recruiting the highest calibre scientists into that grade that we have ever recruited in the time I have been in health care. Secondly, in respect of women in science it is perhaps of interest to note that over 40 per cent of clinical scientists in health care are, in fact, women. This reflects, I think, the fact that science in health care is seen to be a caring use, if you like, of science and therefore it attracts those sort of people to it.

Lord Phillips of Ellesmere

1107. Although Professor Clifton has elaborated the point in some detail I am still worried about the use of this term "clinical scientist" because I am sure to most of us the proposition is that this person is a clinically qualified scientist. All the time you are not really talking about these people; you are talking about research workers engaged in support of clinical research. In my view this is an area of biology which is flourishing exceptionally and these people, or very many of them, are cell biologists and molecular biologists who are not at all tied to working forever in research directly related to health care. They form a very large proportion of people in modern biology and in my view have almost more opportunities than anyone else. I do hope that we can get away from calling these people "clinical scientists"; clinical support staff if you like but not clinical scientists.

(*Professor Clifton*) Lord Phillips raises an important issue. The term "clinical scientist" was coined by the Department of Health and, as I said in my introductory comments, there are two groups. There are clinical scientists employed in that grey area in the NHS. They have less opportunity to move out. They do not really want to move out because they have joined the NHS as a career. I agree entirely with Lord Phillips that there is a large number of graduate scientists of various disciplines working in support of medical research and these do have the opportunity to move. Their difficulty is if they are in a single clinical department and they become too specialised then they do have difficulty but in the broader areas of biological research and so on they do have the opportunity to move.

Chairman

1108. That would be a problem whatever system you had, the person becoming narrowed in the speciality.

(*Professor Clifton*) Yes indeed. The point I was trying to make though is that alongside clinical colleagues who are doing clinical research at the same time in the same laboratory, those clinical colleagues have a clearly-defined career path which enables them to move back out of academia into the practice of medicine and it is accepted that is the way their career should progress. The graduate scientist does not have that.

1109. He can practise medicine either as a whole-time NHS clinician or a whole-time academic. I think we ought to touch on the question of science and industry and in that context also the Research Masters Degree because the latter, at any rate, does seem to be something on which there is approaching unanimity in the CSTI position. Is that right, Sir Colin?

(*Professor Sir Colin Spedding*) Yes it is. As you know, we produced a combined view and it is a unanimously based one opposing the MRes degree. Many of us were not happy with the idea of the Government designing degrees for universities anyway. They could state the need for a certain kind of person or what have you. Our main feeling was that most universities were aware of the reasons given for producing a MRes and were solving those problems in their own ways. MPhils have existed in many universities for a long time and they tend to do precisely what an MRes is designed to do. Our main feeling was that it was totally unnecessary. We did not find in our consultations any support for the idea from most of industry either so that bridges to your other question about the links with industry. I would not like to generalise across universities or, indeed, across industry about whether the links are adequate or not. In my experience they are extremely varied and vary within a university from one department to another, very often depending on the point of origin of the head of that department and what contacts he has already had. If he came from industry the situation is usually not a worrying one. As far as CSTI is concerned its constituent members are virtually all trying to encourage industry/university links and most of them have special arrangements for doing that. The Institute of Physics and the Institute of Biology have a corporate affiliation scheme and, as

[Chairman *contd.*]

you will know, the chemists have their own way of dealing with the problem. Maybe Professor Abel would say a word about that.

(*Professor Abel*) Regarding the MRes there is a problem in terms of training chemists nowadays to the start of a PhD and there is a general perception that from the start of the university career to PhD is now seven years rather than six. What the chemists are proposing is that for a limited number of graduates they move towards an MChem, an undergraduate degree, (something like 30 per cent and not all chemistry departments in the country will take that up) and that that will be perceived as the chemists' way of getting people in a position to do a PhD rather than an MChem. There is a lot of subject specicivity about this. On the question of links with industry it is not always easy for individual departments to discuss their problems with industry and the Royal Society of Chemistry has initiated, with some of their own money, industrial money and, indeed, backing from OST, a series of academe and industrial workshops where senior industrialists and academics meet for two or three days hidden away and work all day and address the sort of problems we are talking about here. We had the first two of these in February. The feedback report is out and I think our Secretary General has offered the Committee a full report towards the end of this month. We are addressing the industry/academic interface and we have discovered that we have mutual problems that will need looking at very seriously.

1110. When would the decision be taken in the undergraduate career to go one way or the other, to opt only for a three-year BSc and, if so, would it be a different kind of degree from that that presently exists or would they move on to a four-year M whatever it might be?

(*Professor Abel*) To some extent, my Lord, that is controlled by access to student undergraduate grants and that decision will have to be made some time early in the second year of an undergraduate's career when MChems will move on to a somewhat different course from BScs and the BScs will finish up after three years. I do not think the three-year honours BSc will be in any way debased by this. It would be somewhat different but still very valuable but the MChem will be the perceived route to go on to research in chemistry.

1111. Do you expect there will be some resistance on the part of local education authorities in providing a student grant for an extra third of the time? If that happens the whole thing comes to a halt.

(*Professor Abel*) On the understanding, sir, that the grants will be passed through the local education authorities but it will really be DFE money, my understanding is that the DFE, certainly for the MChem, has agreed that for a selected number of students that this be would be the way.

1112. That this be counted as a first degree?

(*Professor Abel*) Indeed, that is the important point.

1113. So they will retain eligibility for four years?

(*Professor Abel*) Yes.

1114. This, of course, is going to cost the DFE real money.

(*Professor Abel*) It is also going to cost the funding council money and they have said if you have some four years you have got to have some two years.

1115. What is your view about the advisability of having these pilot schemes? Are they worth doing?

(*Professor Abel*) I think they are worth doing. I am not against them. I do not think they are entirely appropriate for chemistry. They may have a useful purpose in some areas and subjects.

Lord Craig of Radley

1116. The comments you make about possibly seven years and the length of educational courses these days does raise, of course, the problem that people are entering productive work rather later and that in turn runs up against what you might call the biological clock as far as getting married and raising families is concerned and there is a reduction in what you might call the young more active period before people get on to these family and other commitments. Do you think there is a need to re-think the length of the training and the length of the period of education because inevitably the sorts of problems we are facing now are in part driven by the fact people are starting rather later into productive life. Is one way of approaching this to re-think the period of education?

(*Professor Abel*) My Lord, I think that is certainly the case. We are—I hope not awesomely—increasing the length of training and I think this is a desirable thing. I think we are producing better products and products that will be able to cope with society and science as it is now rather than as it was ten to twenty years ago. What I have to assure your Lordship is that the biological clock does not stop. We have more and more married post-docs and young members of staff now than ever.

Chairman

1117. I want to ask you just one question which relates to science and industry. If one looks at the figures for the funding of these contract research workers, it is quite clear that major parts of industry are out-sourcing their research to universities. If that is the case then surely there is a case for charging full costs to industry if it is expecting, in addition to getting the ability, also getting the resources. I hate to use the word "overheads" in view of what Lord Phillips has said. Do you in your interface with industry represent these points to industry and try and secure full costs?

(*Professor Sir Colin Spedding*) Yes, my Lord Chairman. We have a whole variety of different discussions with different institutions and industry because the sectors of industry tend to be different for each discipline as well. These views do emerge and we would all be absolutely in favour of such research being fully costed. Whether some parts of industry would still be as keen to get it done in universities is an open question, but I would hope that the advantages of flexibility that they have by doing it that way would overcome some of the present advantages of getting it on the cheap.

[Chairman *contd.*]

1118. But then if you were to arrive at a proper arrangement with them you might even be able to pay proper salaries to the contract researchers?

(*Professor Sir Colin Spedding*) Yes. We would all support that.

(*Professor Clifton*) There is an important point there because what we are looking at are career prospects for research scientists. This is a permanent research scientist that we are looking to a career for. At some stage in the financing you have got to look at the cost of having the careers of some of those research scientists who are paid off contract rising up the salary scale and, therefore, one has got to look at the sorts of schemes that, for instance, the Wellcome Trust is now looking at of being prepared to fund a limited number of career contract research scientists. I think that argument will also have to carry over to the research councils because whilst at the moment we can, and must, charge for the supervision costs of our academic staff, we cannot charge at the moment for contract research staff, but in the longer term there will have to be that charge onto research councils as well.

1119. Thank you all very much. May I just say in conclusion that if you consider that after this 55 minutes there are points which we failed to elicit from you, you are quite free to send in any written submission to Mr Batt, the Clerk of the Committee. Thank you very much for coming.

(*Professor Sir Colin Spedding*) Thank you, my Lord Chairman.

Memorandum by the Save British Science Society

1. SUMMARY

1.1 Academic Careers

1. The foundation on which the success of British universities has been built is the tradition that universities are places where teaching and research go hand in hand, and where there is, to a high degree, freedom of opportunity for academic staff to define their own programmes of research.

2. However in recent years a number of developments have put the continued excellence of the British university system under serious threat:

- the "well found" laboratory is rare, equipment often obsolescent, and funding inadequate to allow individual initiatives in research;
- intensifying bureaucracy, the continuous search for funds, and a rising teaching load are seriously restricting time for research;
- poor rewards and the deplorable conditions to be endured prior to candidacy—first on graduate student grants and then several years of low pay and uncertainty on short-term post-doctoral research contracts—act as a serious disincentive to enter a career in academic research.

1.2 Short-term Research Contracts

1.2.1 The Growth in Numbers

3. The growth in short-term contracts has occurred in large part because government funding through the UGC/UFC channels has not kept pace with the rapidly changing character of research. The growth has been unplanned, and without regard for adequate rewards and career structures.

1.2.2 Academic Recruitment

4. Estimates [5] of the annual rates of recruitment needed to replace losses of academic staff over the next 10 to 15 years amount to between 500 and 600 a year, aggregated over science and engineering. This is equivalent to about 30 per cent of the numbers currently entering the post-doctoral research pool each year. But the estimates are quite imprecise, do not allow for the needs of the new universities, and we *recommend a careful assessment is made subject by subject.*

5. Of greater concern is the question of whether universities will be able to compete successfully over the coming years for academic staff of the highest *quality.*

6. A survey of recruitment experience in a number of leading university departments was performed for SBS in 1989. The results [10] showed with remarkable unanimity a deteriorating situation in terms of numbers and quality of applicants for both graduate studentships and post-doctoral positions. The situation may well be different five years later, but we *recommend that a proper survey be made of current recruitment experience, across a wide range of disciplines, with some urgency.*

7. Dedicating oneself to a career as an academic research scientist or engineer is rather akin, in degree of material self-denial, to joining a strict monastic order—with the difference that one's family also experiences the vow of poverty.

1.2.3 A Career Structure for Contract Research Staff

8. The growth of the numbers employed on a succession of short-term contracts is not confined to academic research. As a recent article in the Financial Times put it: *"The word 'career' is becoming as meaningless as it was for a 'journey-man labourer' in past centuries."*

9. But this is not a good model for those employed in research, where some continuity is required in staff involved in programmes of research lasting several years and responsible for the development and maintenance of research-specific systems. Nor can research staff be expected to suffer a severe *financial penalty* in place of the *generous compensation* normally received by those taking short-term contracts in other sectors of professional employment.

10. Staff need regular advice on their prospects of gaining a "permanent" post on the academic staff or as Research Support, and on other possibilities for a career. The scheme recently adopted at University College London [11] contains the main elements required (§70) and we *recommend it as model which could be used or adapted by other universities.*

1.2.4. The Future: more short-term contracts, or less research?

11. Both Government and industry are moving towards a more short-term view of their support for the "R"—for research—element of R&D. Central research laboratories in several sectors are being "down-sized" or closed, and there is an increased emphasis on "out-sourcing". A likely result is an increase in the opportunities for universities to take on short-term contracts for research.

12. But if this happens while nothing is done to improve rewards and career possibilities for both short-term and "permanent" academic staff the result will exacerbate an already deplorable situation and increase the disincentives for potentially high quality academic staff.

13. The universities face an acute dilemma: to continue without solving the staff pay and career problems would be a grave risk to the quality of the university system in the long-run; but to raise substantially the charges to industry, the charities, and the RCs for research contracts—at least, say, to the 125 per cent "Hanham level" for overheads—would reduce significantly the level of research activity in the universities. There would be a narrowing of the research base, less diversity, and an enforced separation of teaching and research.

14. We do not recommend either course of action. The first would put the survival of the high quality of teaching and research in British universities in serious jeopardy, and the second would be a gross failure to make the best use of an outstanding asset. *The government has got it wrong, it must be persuaded to fulfil its responsibilities for the health and vigour of the academic research base by providing adequate funding for infrastructure, laboratory equipment, competitive salaries and career possibilities.*

1.3 Mobility

15. Academic positions are rare, once achieved there is a strong incentive to stay put. Almost the only university posts advertised are either at the junior lecturer or professor levels. This is damaging as it can easily lead to stagnation with Departments, and it also acts to discourage movement back and forth between universities and other sectors like industry and the civil service.

16. Low investment in R&D by British industry significantly limits the opportunities for post-doctoral scientists and engineers to find research employment in industry.

17. To assist the take-up of research scientists and engineers by industry, especially small companies, *we suggest the salary of contract staff be continued for a one year transitional period after the contract ends;* the year would be spent taking appropriate courses and working for a potential employer, with the salary costs shared equally between the OST/DTI and the employer.

1.4 Women in Science and Engineering

18. Science and engineering are traditionally boy's subjects, and not for girls. This is the basic attitude problem that has to be corrected, not only to achieve a better gender balance in the professions of scientist and engineer but to ensure both boys and girls benefit from a broad school education which neither neglects the values associated with the "Arts" nor the understanding and appreciation of science and its applications. The quality of science teaching is the key to both objectives, from primary school age to 18.

19. There are indications that greater subject breadth to age 18 will help to encourage more women to take science.

20. In schools:

- primary school teachers need courses of instruction in the teaching of science;
- secondary school science should be taught by teachers with degrees in the core subjects of mathematics, physics, chemistry and biology, with the assistance and facilities necessary for pupils to do significant practical work in class sizes which allow the supervision required to ensure safety;
- at GCSE level "Double-award" science should be the norm [15];
- the over-specialised, narrow sixth form curriculum and A-level examination should be replaced with a requirement for five subjects spanning the "Arts" and "Sciences", but without dilution of standards.

21. We welcome the new Dorothy Hodgkin Research Fellowships open to those who have just obtained their PhD.

22. To enjoy a fully rewarding, successful career, women need help to combine their work with the responsibilities of bringing up a family: adequate maternity leave; provision of créches; and refresher courses after return from a career break.

1.5 *The MRes Degree*

23. Many of the elements of the MRes proposal can be covered in the new four-year Masters degrees which have been, and are being, introduced in several subjects.

24. The four year degree should be the norm for those intending a career as a practising scientist or engineer. The period between entry to a first degree course and the completion of work for a PhD should be *at least seven years.*

25. It is essential that students in science and engineering graduating with a Masters degree (with the possible exception of those in mathematics or a theoretical specialisation) should be "laboratory-wise" and familiar with at least some of the latest research techniques.

26. Communication skills should be developed at school, including the sixth form, and continue to be practised through university and post-graduate studies. Management-related topics should not be *required* as part of the Masters or PhD courses.

27. We strongly oppose any reduction in the number of PhD studentships.

28. The small pilot scheme for the MRes may show it to be of value in some disciplines.

2. ACADEMIC CAREERS

29. The universities are unique in carrying the vital, dual responsibilities of undergraduate teaching and the training of young scientists and engineers in research while advancing the frontiers of science and its applications.

30. The 1994 Forward Look [1] sets these principles our clearly: "*. . . the science and engineering base* (universities and research councils) *must concentrate on its proper role: the training of highly skilled men and women and the conduct of research at the frontiers of knowledge. . . . Basic research will be sustained by the universities, at their discretion, through the resources made available to them by the Higher Education Funding Councils; . . .*"

31. Funds given to universities to perform research buy that research and also add value to both the teaching of undergraduates and post-graduate training.

32. The foundation on which the success of British universities has been built is the tradition that universities are places where teaching and research go hand in hand, and where there is, to a high degree, freedom of opportunity for academic staff to define their own programmes of research and seek the funds necessary to pursue them.

33. As Max Perutz has written [2], *"In Germany and France* (and he might have added, Japan) *a young scientist has to work at his professor's bidding. Here a gifted young scientist who wins a university position is independent and can apply for a research grant to pursue his own ideas".* This independence, in Perutz's view, underlies *"the greatest strength of British science, its originality."*

34. Appointments to university posts generally follow several years in post-doctoral research. This provides an opportunity to gain valuable experience of research while being comparatively free of administrative and other non-scientific duties, and helps candidates for academic appointments to establish their potential as scientists and engineers. In this the UK is like the USA, but unlike other countries such as France.

35. However in recent years a number of developments have put the continued excellence of the British university system under serious threat.

36. The Higher Education Funding Council leg of the dual-support mechanism is failing to provide the funds required to maintain "well found laboratories"[1] and replace obsolescent equipment. There is not the necessary margin of funding to allow universities to take initiatives in research independent of Research Councils or other external bodies, and the assumption made by the authors of the 1994 Forward Look (§30) cannot be sustained. Bureaucracy and bureaucrats are multiplying, draining time, energy and resources which should be spent on teaching and research; the task of raising funds to support research, and pay contract staff, is never ceasing and frequently frustrating; teaching loads are increasing as student numbers rise and academic staff numbers fall.

37. These factors are already growing to be strong disincentives to those who might wish to seek an academic career. When the poor rewards and the deplorable conditions to be endured prior to candidacy—first as graduate students and then post-doctoral researchers—are added, it is no wonder that many of the best decide to go where they can command much better salaries and prospects (see section 3.2).

38. High-flying young research scientists and engineers now tend to choose a university lectureship as a last resort, preferring instead to be employed in a relatively better equipped and resourced research institute funded by a charity, research council or company. This must be damaging to the vitality and success of university research, and means that students will not be taught by some of the brightest scientists and engineers. This will lead, in the long term, to a declining spiral of quality in British universities. These factors are considered to be already turning university departments in some fields into scientific backwaters, further eroding their ability to attract the best.

3. Short-term Research Contracts

3.1 *The Growth in Numbers*

39. Between 1977–78 and 1989–90 the number of scientists and engineers in wholly university funded (WUF) academic posts droppped by 10 per cent, while the number not, or only partially, university funded (non-WUF) more than doubled (137 per cent), rising from 22 per cent to 42 per cent of the total staff (data assembled for the 1992 ACOST report on Research in the Universities [3]). The increase in non-WUF staff approximately balanced the loss (24 per cent) of WUF posts in the Physical Sciences, but led to substantial increases in staff for the Biological Sciences (38 per cent), Engineering and Technology (32 per cent) and Maths and Computing Sciences (39 per cent, but mainly Computing). Medical and medically related subjects were not included in this survey, but other data on Research Assistant posts show substantial increases in non-WUF funded staff occurred in this sector also.

40. The study of university research personnel in the years 1980 to 1989 carried out for the SERC by Atkinson, Bond and Mullins [4] gave information on the sources of funding for Research Assistant appointments in grades 1A and 1B. More than 50 per cent of the *increase* over the period occurred in the Medical and Life Sciences, just over 20 per cent in Engineering and Technology, 12 per cent in the Physical Sciences and Mathematics, and about 10 per cent in Computing. Of the total increase in funding for Research Assistant posts, the charities and industry together made up over 40 per cent, the research councils 22 per cent, Government 6 per cent, overseas sources 4 per cent, and "other" about 30 per cent[2].

41. The great majority, if not all, of the non-WUF staff, including most of the Research Assistants in grade 1 and higher grades, are employed on short-term contracts.

42. Several factors combined to drive this huge and rapid growth in non-WUF contract research staff:

- the explosion in opportunities for discovery and advance in all fields of science and the application of science made possible largely through the advent of new experimental techniques—such as NMR spectroscopy—allied with the use of increasingly powerful computers and analytical software;
- in parallel, effective exploitation of the full potential of this new, and often expensive, equipment led to the formation of research teams, and the emergence of graduate and post-doctoral scientists and engineers working in a largely research-support role—providing the necessary continuity in research programmes stretching over several years, and carrying through the maintenance and further development of the research technology;
- the pace of advance at the frontiers is set by the best international competition, without front-line facilities and research support even the brightest scientists can quickly fall behind;
- for UK universities, this quickening of the pace coincided with a severe squeeze on dual-support funding via the UGC/UFC which required the *loss* of academic posts and no possibility of increase in supporting staff; the result, inevitably, was recourse to all possible other sources of finance for

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[1] The phrase has disappeared from the Funding Council vernacular.

[2] Unfortunately not identified.

research an these, invariably, were limited to short-term contracts largely from non-Government sources.

43. The rapid growth has had two consequences, one leading from the other. It was unplanned, and without proper regard for adequate rewards and careers for those on short-term contracts—low pay has been combined with high insecurity. This unsatisfactory situation has become a significant disincentive for some of the brightest scientists and engineers who might have chosen to enter post-doctoral research in the hope of gaining one of the rare academic posts falling vacant—but not immediately axed.

3.2 *Academic Recruitment*

44. In 1992 just over 50 per cent of the wholly university funded (WUF) academic staff in the "old" universities[3] were aged 50 or over in each of physics, chemistry, and engineering; the situation was better in mathematics (34 per cent) and the biological sciences (41 per cent) [5]. As the peak in the age distribution generated by the expansion which occurred in the 1960s passes through retirement in the next 10 to 15 years there will be an increased demand on recruitment.

45. Estimates of the annual rates of recruitment have been given for science and engineering in the old universities in a report commissioned by the SERC from the Institute of Manpower Studies [5]. Two cases were considered: one assuming straight replacement, the second providing for a growth in academic staff to keep pace with the expected increase in student numbers. Aggregated over science and engineering the average annual recruitment numbers are about 500 or 600 for the two cases, with peaks occurring in different years for the various subjects.

46. A main source of recruits to academic posts will be the pool of post-doctoral researchers on Fellowships and short-term contracts. Universities should resist the temptation to recruit only from the youngest, and so cheapest, end of the age distribution in order not to recreate a pronounced age peak.

47. The Royal Society Fellowships and, in the medical and medically related fields, those of the Wellcome Trust and the MRC provide attractive positions for post-doctoral scientists while they look for an academic post. The MRC's Senior Fellowships are tenable for up to 10 years. A recent and very welcome innovation is the Research Fellowship scheme introduced at Warwick University, giving support for up to six years with a good prospect of a permanent position at the end. This example should be widely copied. Fellowships like these also help to attract young scientists and engineers to return from abroad.

48. In 1989 the post-doctoral pool held rather more than 2,000 scientists and engineers [3].

49. However if the research being performed by the non-WUF researchers is to continue at the same level—employing the same numbers and quality of staff—the WUF academic staff losses will be made up, directly or indirectly, from the freshly graduating PhDs. These, in 1993–94, numbered about 4,500 in the sciences and engineering together [6].

50. Thus, on this rough model, the academic recruitment needs appear to be met from between 10 per cent and 15 per cent of the annual PhD output. Not all fresh PhDs choose to remain in academic research, less than about 40 per cent in 1992 [7], so the number required is equivalent to about 30 per cent of those entering the pool. In addition of course, there are the many potential candidates outside the pool, in Research Council, Government, industry, and charity laboratories, as well as those who may wish to return from overseas.

51. The figures are quite imprecise, there are quite significant variations between subjects, and the needs of the new universities for PhD qualified staff have not been considered. *A careful study is needed to identify any possible shortfalls,* nevertheless it appears that the overall needs for academic recruitment over the coming decade can be met numerically.

52. Of greater concern is the question of whether universities will be able to compete successfully over the coming years for academic staff of the highest *quality*.

53. The swing away from science begins in the schools. This has been followed, according to the ACOST report (3), by a decline in the proportions of the brightest graduates, in both science and engineering, choosing to embark on a research career—especially in academic research.

54. The pittance which is the graduate student grant, followed by the dismal pay and uncertain prospects of life on a series of short-term research contracts constitute a very considerable financial penalty for those who decide to take this path in the hope of eventually securing an academic post. It is a loss, compared to the earnings of their peers who go into employment after graduating (or even after A-levels), which takes many years to make up, if it ever can be.

55. The graph below was published in 1989 (8); except for the data on research scientists, it was based on a 1989 report by the Reward Group (specialists in remuneration analysis). The "Research Scientist" line was derived from the value of SERC post-graduate grants plus £500 p.a. for extra earnings, and then the Grade 1A (with PhD) Research Assistant salary scale.

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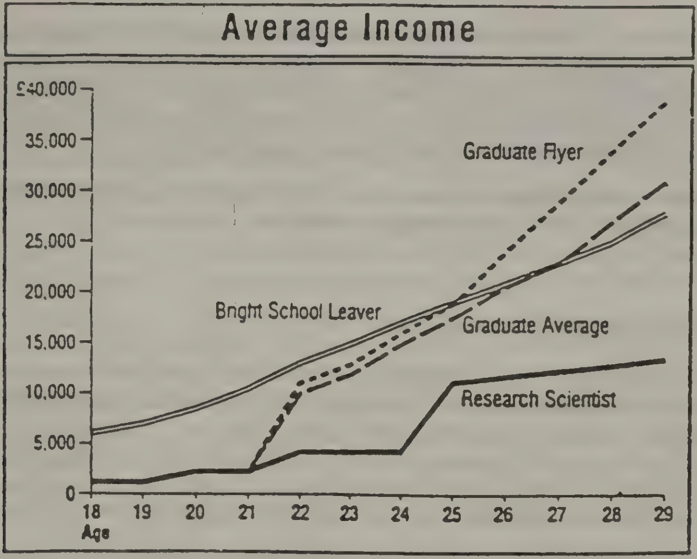
[3] Equivalent information for the ex-polytechnic sector seems unavailable.



It takes only a glance to appreciate the magnitude of the penalty paid by those dedicating themselves to a career in academic research. It is rather akin, in degree of material self-denial, to joining a strict monastic order—with the difference that one's family also experiences the vow of poverty.

56. Recent data show that by the age of 30 an average accountant can expect to be at least £100,000 ahead of an academic scientist in integrated salary received since the age of 22 and will continue to increase the lead. School teachers are also ahead at age 30.

57. For those who gain an academic post, coping with all the difficulties and frustrations outlined above keeps them long hours away from their families and all for a financial reward that is derisory. Pay scales have fallen well behind that for the average non-manual worker, and have barely kept above inflation. A comparison of the salaries for chemistry graduates in education and industry is given in the table:

Median Salaries for Chemistry Graduates in R&D

Royal Society of Chemistry data for 1994 (9).

Age	*Education*	*Industry*
	£	£
25-29	17,200	21,100
40-44	25,000	34,000
55-59	29,700	40,000

Integrated over a career, but especially for younger staff, these are very substantial differences which can no longer be justified by appealing to the privilege of academic tenure.

58. Once upon a time the university Lecturer and civil service Principal (G7) scales were linked. Now the lecturer scale (£14,765 to £27,473) *ends* just above where the Principal grade (£24,724 to £38, 290) *starts;* and the basic Professor salary (£35,859) is *less* than the Principal's maximum, instead of being in the range of the Under Secretary's (G3) salary (£54,000 to £64,000).

59. It should be no surprise therefore if this situation seems, at last, to be acting as a significant disincentive to consider an academic career in science or engineering for many of the brightest students, easily capable of achieving success in other fields.

60. The most worrying evidence is anecdotal—but convincing.

61. Experience in recruitment was sampled in a small survey of leading university departments performed for SBS in 1989. The unanimity of the responses, across a wide range of disciplines from engineering to computer science, mathematics, the physical sciences, biology and physiology amazed us. Heads of Departments, almost all with scores of four or five in the UFC selectivity exercise, described a rapidly deteriorating situation in terms of the numbers and especially the quality of applicants for both post-graduate studentships and post-doctoral research positions.

62. These intimations of crisis were explained to John MacGregor, then Secretary of State for Education and Science, when an SBS delegation met him in October 1989, and were followed up at his request by a written report. (This was also submitted as evidence to the House of Commons Education, Science and Arts Committee (10)). We suggested the issue warranted a more thorough examination; simple statistics tend to hide such problems and few Heads of Department are likely to state publicly that they are unhappy with appointments recently made!

63. That was five years ago. The recession and other factors may well have altered the picture temporarily, although we know of recent difficulties in recruitment in engineering and computer science for example. The underlying problems remain and in most respects are worsening. We fear that over the next decade universities will lose their attraction for the highest quality graduates in science and technology for reasons of both poor salary and reduced opportunities for free-ranging research.

64. *This question deserves urgent investigation, in the form of a survey of current recruitment experience and trends in university departments across a wide range of disciplines.*

3.3 A Career Structure for Contract Research Staff

65. The growth of employment on a succession of short-term contracts is not confined to academic research. Under the convenient euphemism of "flexibility" it is now becoming regarded as the most efficient model for employment generally. As a recent article in the Financial Times put it: *"The word 'career' is becoming as meaningless as it was for a 'journey-man labourer' in past centuries".* Managements like it because it involves no long-term personnel commitments and is cheap. There is therefore no need to look ahead, to exercise foresight on staff needs in number or kind; short-termism becomes "best-practice".

66. Whether this fashion will continue in favour or be found wanting, in the longer term, it is not a good model for research. Provided quality and "promise" are maintained programmes of academic research stretch over several, often many, years and are not most efficiently pursued with a high turnover of "journey-men/women researchers" worried the contract may not be renewed however successful their work may be.

67. Unlike accountants, for example, whose expertise and methods are general to all accountants, the contract researcher develops a particular grasp of the history, fundamentals and special techniques of a research project which is lost on departure, and not quickly regenerated in a successor. Also unlike employees on short-term contracts in other types of employment, contract researchers in universities receive no compensation in the form of high pay and other benefits; instead they suffer a significant financial penalty.

68. This is not to argue for indefinite contracts for all, there must be some invigorating inflow of new talent, and the training element of academic research is realised in those leaving for other employment. But at present the balance is all the other way—neither providing an adequate and fair career opportunity, nor a necessary degree of stability and continuity for efficient research.

69. The scheme recently adopted by University College London [11] is an example of what should be done. It seeks to provide a career structure with the possibility of long-term security of employment for Contract Research Staff who demonstrate high potential value to the College. The main elements are:

- a sequence of assessments: the first at one year after confirmation of appointment, then at three, five and eight years;
- at three years a decision is already made to inform those not thought likely to be given permanent employment, these then leave the scheme although they may continue in post if external funding exists;
- at five years, those on track for long-term employment are either confirmed or, if their promise has not been maintained, told the bad news; there is always a minimum one year notice of the ending of employment;
- at eight years those confirmed at the five year stage are, if it hasn't happened before, given an indefinite contract; from this point on, should external funding cease the College is committed to continuing the appointment and to provide similar terms and conditions of employment, including promotion, as for a permanent member of academic staff.

70. This mechanism ensures that contract staff are regularly informed of their prospects within the College, and do not drift into an indefinitely long series of short-term contracts. Of course there is also the possibility that some, especially those already on Royal Society Research Fellowships or with similar awards, will transfer to academic posts in the College or elsewhere.

71. The majority of those in the pool of post-doctoral research scientists and engineers will not succeed in getting an academic or a permanent Research Support post. This is also a problem that needs to be addressed, although at 3 per cent (in 1991) unemployment among PhD graduates is small and significantly lower than that for first degree graduates (13 per cent). With their experience and training in research they are a resource of great value in many areas of employment. Research contract staff should be advised to consider a much wider range of eventual career possibilities, including teaching, and be helped to make the transition by being supported while taking special courses or spending time in industry. There is an analogy with the case of officers released by the armed forces, who are given courses to help equip them for a civilian job. We return to this topic below (§95).

3.4 *The Future: more short-term contracts, or less research?*

72. The explosion in the numbers employed in the universities on short-term research contracts during the 1980s was due to a combination of factors. In large part these were the wish of the universities to fill the widening gap between Government funding and the costs of exploiting expanding opportunities at the frontiers, and the increasing availability of short-term funds mainly from industry and the charities.

73. Now, in the 1990s, there is no sign that the Government has understood the situation and a new factor seems to be at work. Both Government, through its policies for Government Research Establishments (GREs), and industry are moving to an even shorter-term view of what research they will support "in house". This is likely to feed further growth of the short-term contract phenomenon in the universities.

74. Reductions in Departmental funding of R&D, the adoption of "market testing", moves to greater dependence on outside contracts, and the privatisation of GREs which have in the past been major contributors to the national R&D effort have largely ended anything but short-term research in a number of areas of science and engineering within the GREs and ex-GREs, decimating several leading research teams.

75. The same trend is now seen in industry, where central laboratories are being closed or drastically reduced in strength. British industry, historically weak in its investment in R&D, especially D, and seemingly unable to increase expenditure to the levels comparable with international competitors, is now seeking to increase D but apparently at the expense of R. Major research facilities are being shut down and expensive equipment thrown away—some given to universities instead of being put in the skip "Out-sourcing" of R&D is the current by-word of "efficient" management. One experienced observer has called the effects on industrial research laboratories as nothing less than "dramatic".

76. Whether intentional or not, the 1993 White Paper [12] and its emphasis on turning the science base into a vehicle of "wealth creation" in closer unison with industry gave industry a clear invitation to transfer a significant part of the "R" end of its activities into the universities.

77. One potentially damaging effect may be the loss of staff from the "R" side of industrial R&D who are those most able to form an effective bridge across the interface with colleagues in academia.

78. Distinguished refugees from Government and industrial laboratories are now increasingly to be found in university posts, applying for Research Council grants and claiming HEFC support to continue research formerly paid for by industry or by Government Departments, like DTI and MAAF—intensifying the competition for already inadequate science base funds.

79. Additional "out-sourcing" funds from industry will be available to increase the numbers of contract researchers on "soft" money. But increasing the number of short-term research staff while doing nothing to provide adequate rewards and a fair career structure will exacerbate the deplorable conditions in the post-doctoral pool.

80. The problem is that to establish acceptable career structures for both contract and academic staff, with respectable and competitive rewards able to attract the best, costs money which just isn't in the system. As the ACOST report [3] has already put it, are *"the universities trying to do too much for the resources available"*?

81. Government has made it clear that staff employment conditions are a problem for the employers, the universities, and has washed its hands of the matter. It continues to reduce funding in universities for teaching and research, at the same time expecting student numbers to rise and universities to do more to help industry[4].

82. Both Government and industry fail to understand that research, and the scientists and engineers who are needed to perform research, cannot be treated like water from a tap—off today, but on again perhaps next year. No doubt when the tap is turned "water" will appear, but its quality will be questionable.

83. It seems the only solution is to increase substantially the overhead charged on all research contracts—for industry, charities and the Research Councils—say at least to the "Hanham figure" of 125 per cent of all direct staff costs. This itself would no doubt significantly reduce the level of research activity, but it could allow a new balance to be set between university research aspirations and the ability to attract the best staff.

84. There would be other prices to pay. In such a regime the bigger and longer established research universities would be better able to provide competitive staff conditions. The operation of the market would tend to shrink the research base, and reduce diversity; universities would be quite unable to finance research not funded by contract, and any remaining effectiveness of dual support to fund independent research would be killed. The proportion of teaching only Departments, and probably universities, would be larger; the separation of teaching and research would be driven further in all universities.

85. The universities face an acute dilemma: to continue as now—perhaps even worse, to allow a further expansion of short-term contracting, becoming a sort of scientific "Manpower Agency"—would gravely risk the long-term quality of the British university system; but to raise substantially the charges for research would cut research activity, perhaps causing the loss of some leading researchers, and have other damaging consequences.

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[4] In the last five years funding per student has fallen by 25 per cent in real terms, and is planned to fall a further 9 per cent in the next three years; the HEFC allocations for research are also being reduced in real terms.

86. We cannot recommend either course of action. The first puts the survival of the high quality of teaching and research in serious jeopardy, and the second would be a gross failure to make full and best use of an outstanding asset, a particularly blind act with the country entering a century of even fiercer competition in science based, high technology industries.

87. *The Government's policy is wrong. It must be persuaded to fulfill its responsibilities for the health and vigour of the academic research base by providing the necessary funding for infrastructure, laboratory equipment, and competitive salaries and career prospects.*

4. Mobility

88. With the reductions which have occurred in numbers of academic posts, positions are rare enough in Britain that, once achieved, there is a strong incentive to stay put. Practically the only university posts advertised are at the junior lecturer or professor levels. This is damaging as it can easily lead to stagnation within Departments. Together with the wide disparities in pay and other benefits, it is also an impediment to mobility, in both directions, between universities and industry, education, and the civil service.

89. In the context of wealth creation, one of the most important contributions the universities can make is to train young scientists and engineers in research. But, there is a problem: industry, with a few important exceptions like the pharmaceutical sector, does not offer attractive rewards and career possibilities; indeed, because of its generally low level of interest in research and development, industry does not wish to employ many scientists and engineers in research—it prefers accountants and pays them more[5].

90. A measure of industry's reluctance is revealed by a comparison of the numbers of qualified scientists and engineers employed in R&D in Britain with those of other countries. The number per head of the workforce was, in 1988, 50 per cent higher in Germany and nearly twice as high in Japan and the USA [13]. To match these countries the total number of graduate scientists and engineers employed in R&D in Britain would need to increase by more than 50,000.

91. In a study of the employment of scientists and engineers in Britain and Germany for the SERC, Mason and Wagner [7] of the NIESR found the numbers of "home students" (ie those domiciled in Britain or Germany) in engineering and the physical sciences graduating at the Masters level to be four times greater per head of population in Germany; and, in spite of taking five or more years longer than in Britain, the number of Doctorates was nearly 60 per cent higher. In addition, the number going on to higher degrees was rising much faster in Germany.

92. Storey and Westhead [14], have found the fastest growing small companies, generating the bulk of new employment, were high tech firms led by highly qualified scientists and engineers, frequently with a PhD.

93. In Germany the Fraunhofer Institutes provide an effective, collaborative association between academia and industry, and at the same time act as a conduit for the transfer of young researchers into industrial employment.

94. Another very effective practice in Germany with the specific object of stimulating the employment of research scientists and engineers by small companies is to supply the salary costs for the first one or two years.

95. To assist the take up of research scientists and engineers by industry, and especially small companies, *we suggest a transition period of one year after the ending of a contract during which appropriate courses could be taken and time spent working for a potential employer.* A similar path could be taken for transfer to school teaching, or into the civil service. The salary and other costs would be shared between the employer and the OST/DTI.

5. Women in Science and Engineering

96. Science and engineering are traditionally boy's subjects, and not for girls. This is the basic attitude problem that has to be corrected, not only to achieve a better gender balance in the professions of scientist and engineer but to ensure both boys and girls benefit from a broad school education which neither neglects the values associated with the "Arts" nor the understanding and appreciation of science and its applications. The quality of science teaching is the key to both objectives, from primary school age to 18.

97. Since the problem begins at an early age in schools, change is inevitably going to be slow. Activities such as those sponsored by the Engineering Council which get working scientists and engineers into the classrooms should be extended, and greater contacts with local schools by university and industry encouraged.

98. Primary school teachers need courses of instruction and help in the teaching of science. In secondary schools science should be taught by teachers with degrees in the core subjects of mathematics, physics,

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[5] This fact does not escape the notice of bright sixth formers, and their parents, perhaps accounting for the rapid decline in the proportions taking all-science A-levels.

chemistry and biology. There must be adequate technical assistance and facilities to allow pupils to perform significant work in practical classes of a size small enough to allow proper supervision to ensure safety.

99. "Double-award" science at GCSE, (with separate identification of performance in biology, chemistry, and physics) should be the norm [15].

100. The proportion of pupils taking science (including maths) A–levels dropped from 43 per cent in 1962 to only 16 per cent in 1993, while those taking a mix of subjects rose from 9 per cent to 35 per cent and is still rising [15]. A recent DfE report [16] gives figures for boys and girls separately showing that the proportions taking science and maths only nearly halved between 1984 and 1993 in both cases; from 40 per cent to 23 per cent for boys and 19 per cent to 11 per cent for girls; the boys lost from science went approximately equally to mixed and non–science subjects while rather more girls went to non–science. While too few girls opt for science anyway, the main message is that overall pupils are voting with their feet away from the narrow science A–level.

101. In Scotland, where students take a five–subject Higher Certificate, in 1987 the proportion (23 per cent) of Scottish women gaining three or more passes in the Higher was somewhat higher than that for men and nearly twice the proportion (13 per cent) of English and Welsh men and women getting two or more A–levels [17]. The proportion doing science was not given, but was likely to be higher than in England and Wales. Other experience, from Liberal Arts Colleges[6] in the USA, indicates that when a broad subject spread is available the participation of women in science can be as much as twice that when there is early and narrow specialisation [18].

102. It is said that only three countries have a three subject examination like the A–level: England, Wales and Ghana. A–levels must be broadened to require at least five mixed "Arts" and "Science" subjects without loss of standards; a feat managed on the Continent and in Japan where the hours in school are longer [15].

103. We welcome government funding of the Royal Society's new Dorothy Hodgkin Research Fellowships open to first class scientists who have just obtained a PhD.

104. To enjoy a fully rewarding, successful career women need help to combine their work with the responsibilities of bringing up a family: adequate maternity leave, provision of creches, and refresher courses after return from a career break.

105. We welcome the new Development Unit on Women in Science, Engineering and Technology set up by the OST, and look forward to considering its recommendations.

106. The most effective positive influence on girls and young women is the presence of role models. Until there are more women in science and engineering, and some are seen to reach the highest ranks—as is beginning to be the case in Commerce—the rate of improvement will be slow. Active discrimination, say by setting quotas, can be counterproductive; what is required is a commitment to judge applicants for posts strictly on quality.

107. Campaigns advertising the achievements of women scientists and engineers will help in the absence of role-models, but since the status in society of scientists and engineers in general is not highly regarded they face a double problem. Perhaps we need a Campaign for People in Engineering and Science.

6. The MRes Degree

108. In agreement with the Royal Society we believe that, as initially proposed, the MRes was too inflexible and paid too little regard to developments in the Masters degree already underway in several disciplines. However, we support the view that the period between entry to a first degree course in the sciences and engineering and the completion of work for a PhD should be *at least seven years.* In few, *if any,* other countries is this period as short.

109. The four year degree should be the norm, at least for those intending a career as a practising scientist or engineer. This will be necessary to achieve better parity with equivalent first degrees in Continental Europe, and to accomodate to the lower depth of knowledge already a feature of students at entry. The fourth year should provide some experience of research and, where appropriate, of work in industry. We welcome an increase in the number of CASE awards, and wider use of the Teaching Company scheme.

110. Communication skills should be developed throughout the degree course, and indeed one of our major criticisms of the narrowness of A-levels for those choosing science is the enforced withdrawal—at a critical stage in development—from the exercise of forming and articulating thoughts on general issues so that they can be successfully communicated to others. By the fourth year of a degree course it is far too late.

111. It is essential that all students in science and engineering, especially those taking the four years Masters degrees[7], become "laboratory-wise", and gain familiarity with at least some of the advanced

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[6] The Colleges most successful in turning out high quality first degree science graduates are those insisting that *undergraduates* take part in research.

[7] Except those in a theoretical speciality.

techniques of research. Collaboration between departments, institutions, and industry could help to ensure this takes place.

112. We do not believe lectures on Business Administration or Personnel Management or Accounting Methods etc. should be *required* parts of a Masters degree course. There is little enough time as it is, and there are some training matters which any good employer should be responsible for and is best able to provide in the most appropriate way. Many such skills are most easily and effectively acquired through "on-the-job-training", which can be supplemented with part-time courses. The *choice* should lie with the student who depending on career intentions, might well add strings to his or her bow by taking additional courses; say in economics and Japanese.

113. A part of the case made for the MRes as a pre-requisite for commencing research for a PhD was that it would provide a basis for deciding whether the student had the potential to obtain an academic appointment. There was an implication that the number setting out towards a PhD should be limited to the number likely to get such posts. There are two fallacies here: academic careers are not the only possibilities for holders of the PhD; and the test of suitability for an academic career requires at least three or four years of post-doctoral experience. We firmly oppose the suggestion that the number of PhD studentships be reduced.

114. The pilot scheme for one year "self-standing Masters degrees by research" may well be of interest to students in some fields, adding to the present range of options in an area where there is diversity in the needs of different disciplines and employment sectors.

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Examination of Witnesses

Professor J F Lamb, FRCPE FRSE (SBS Chairman), Chandos Professor (Emeritus), School of Biological & Medical Sciences, St Andrews, Professor J P Connerade, Department of Physics, Imperial College, Member of Board of Directors Aimé Cotton Laboratory (CNRS), Visiting Scientist University of Bonn, Dr M Freeman, MRC Laboratory of Molecular Biology, Cambridge, Dr J H Mulvey, Executive Secretary, SBS, Professor P T Saunders, Department of Mathematics, Kings College London, called in and examined.

Chairman

1120. Good morning, Professor Lamb. Do you have any particular spokesman, as it were?

(*Professor Lamb*) Yes.

1121. Dr Freeman, you are from the MRC. We have Dr Mulvey and who else?

(*Professor Saunders*) Professor Saunders. They do not appear to have made a sign for me. My name was on your list. I am from Kings College London and my subject is mathematics.

1122. I know some of you were sitting in on the previous session so you know the kind of things in which we are interested. We have also got your memorandum which we have read. Are there any points which you would like to highlight or other additional remarks to make at the beginning before we go into our usual question and answer session?

(*Professor Lamb*) Yes, my Lord Chairman. We had arranged that I would say a few points as an introduction and then myself and my colleagues would be targeted for the various questions. Firstly, we welcome this inquiry by your Lordships because we feel it is a very important matter for universities which has, in our view, been somewhat neglected. Universities depend on attracting very able young people to stay with them after their first degree for a time to learn research techniques and to do research themselves. Some of these will take academic posts but many will not and we think the current career structure for those who do not take academic posts at the moment is not working well. We think that science PhDs should be seen as a national resource which is not always well used and so we think that help is needed to make best use of them. Personally, I rather fancy the forces system in which they take a good deal of trouble to put ex-officers into various positions. This does not happen at all in universities. Finally, we think the Government has a duty to arrange funding so that it is possible for universities to create a good career structure. This, as I say, is not the case at the moment. Thank you.

1123. On the question of what might be regarded in career terms as a more caring attitude in the armed forces, do I take it that you were there supporting what is referred to in your document as the University College London scheme?

(*Professor Lamb*) Yes. John, do you want to tackle that point?

(*Dr Mulvey*) Certainly we think that during the period in which post-doctorates are in a succession of short-term contracts—we are not saying that everybody should be given a permanent position by any means, that is part of the exercise of developing people's experience and capability in research—we need to put more effort into advising them as to possible career paths, we need to put more effort into drawing their attention to possibilities other than just an academic career. Also, as the University College system does, we need to provide a structure for decisions to be made at a succession of stages so that one does not end up with people who have drifted from one temporary position to another and then when aged 35 or 40 discovering there is not going to be a long-term academic career for them.

1124. One of the things which is bound to be raised as a question is whether in the expansion of the universities one can manage these people well except in large institutions which have quite a number of them so that there is enough, as it were, money to enable them to do some of the bridging in the career breaks which these people would otherwise have. Have you considered this and do you therefore think that it is almost inevitable that research would tend to become concentrated in some big and successful institutions? The other side of that coin is that it would be unwise to spread research money too thinly.

(*Professor Lamb*) One of the trends that is happening even in quite small universities like my own of St Andrews is that biology departments are amalgamating. When I was in physiology we had 12 staff; now we have a school of biology with 72 staff and ten professors and hundreds of students, and so there is quite a large number of postgraduates there. Last year, for example, our research income was £7 million to this one department and, therefore, in a way we have got round that problem because we now have the postgraduates having seminars and so on and talking to each other.

1125. Are you also saying that the department is the best place where the careers advice might be given and the decisions taken? We did see in Edinburgh last week people who told us about their particular careers advice service taking a part in this and I think it struck those Members who heard about it as very helpful.

(*Dr Mulvey*) I cannot say that we have looked at this in any detail, but it would seem reasonable that the department must play a leading role because it is the department that has contacts with the outside world which are most relevant to the people who are taking short-term contracts within that department. I would like to go back to one implication of your question. While it is true that if the large departments in small universities can bring themselves together that will help, it will tend to be a greater problem for the smaller units of small universities. One has the dilemma there that we believe one must be able to keep research activity going on in smaller departments. Small groups are often very successful. We are very fearful of the other side of the coin in which one could end up with research concentrated

[Chairman *contd.*]

in too few centres. There is a problem here that we believe one has to find a way to solve.[1]

1126. Dr Freeman, did you want to say something on this subject? I have a feeling that your name is somewhat familiar. Were you one of the British scientists who were in the States?

(*Dr Freeman*) Yes, that is right.

1127. Did you write to me?

(*Dr Freeman*) I am sure I have in the past. I have not been there for quite a long time. I came back to this country about three years ago. I was instrumental in setting up a group called "British Scientists Abroad" and then chaired it for several years.

1128. In that case, we have corresponded.

(*Dr Freeman*) That is right.

1129. May I just say that we have been to the United States, to Washington, Philadelphia and Boston, and the same problem exists there. This category of contract staff is there known as the "gypsy professors". You will know all about that. It would be very useful to us if you having experience of both sides of the Atlantic would give us the benefit of that experience and tell us whether there are any lessons that we can learn?

(*Dr Freeman*) I do not think I have anything to add to the question of size of department and whether small departments will be able to cope in the future. I think the point that Professor Lamb made about the amalgamation of biology departments is an important one and is a trend that I have seen on both sides of the Atlantic. What worries me more, to be honest, is that there are two elements to the problem of academic careers in this country. The first one is that since one of the main functions of universities is to train people for all sorts of careers outside academia, there will be a pyramid structure of academic careers, and those people who leave the system and are highly trained and valuable workers need to be able to be helped to be placed in other careers. There is also a different problem which is one of making academic careers sufficiently attractive to ensure that the best and the brightest scientists actually stay within academic careers in this country. That is a point which has been touched upon this morning and I think it is an important one because unless we can attract the best people to remain within academic careers that is a recipe for mediocrity and decline within university departments, which is something I am worried about at the moment, and am actually seeing beginning to happen.

1130. Can you tell us what the perceived impediments are to recruiting the best people now?

(*Dr Freeman*) My own field is molecular biology. What I see to be the problem is for new staff coming into lectureships for the first time. A university lectureship is now seen as really the third tier, the job of last resort, which is an alarming prospect for the future of universities.

1131. For financial reasons?

(*Dr Freeman*) For all sorts of reasons. If I may elaborate on that for a moment. What I think is that people prefer to go into research council institutes or research charity laboratories, or to take up the Royal Society senior fellowships or the Wellcome fellowships or the research council fellowships of a similar kind. The last resort is to go into a university department as a lecturer because they perceive that the teaching load is increasing, the salary is a good deal lower than those offered in alternative employment, and the opportunities for establishing your lab and getting going at that early stage in your career are many fewer in university departments. I did a little straw poll last week, when I knew I was going to be talking to you, amongst colleagues of mine who have established labs over the last two or three years on either side of the Atlantic. I asked them about their teaching commitment and their salaries and the amount of money they were given with which to establish their labs and the numbers I came up with, I will not bore you with the details, were extraordinary. In America at the moment the average setup deal for a new assistant professor is of the order of $300,000 to $350,000 to establish their lab and their average salary now is about $60,000 in biological sciences, which is of course about £40,000. Apparently the equivalent person in Britain is rarely given anything to set up a lab. Sometimes they get up to £10,000 but for first jobs I have not heard of more than that in a university department. The salary for a 31- year old lecturer is £17,000, so less than half the average salary of an equivalent person in America. Incidentally the purchasing power of the dollar is such that the American salaries are greater than they seem to be in terms of exchange rate. I think those are very real impediments to attracting the best people into university departments. One last point I would like to make in support of my thesis that university jobs seem less attractive now, is that talking to a few people who are now in research council institutes or charity labs, the setup offers they are being made are much more equivalent to American ones. I have a couple of examples of people being paid £300,000 over five years to staff and equip their lab for that first five years, which is very analogous to the kind of deal being offered in America. When you compare those sort of numbers you can see that to tempt the best people back, from the States mostly but other countries too, is very difficult indeed. My perception of it is very clearly they do not come back to university lectureships; they would rather stay abroad. If you will excuse me using the cliché of the "braindrain": in a rather specific way, it does exist, it is an important problem and one we should be rather worried about in this country.

1132. If they do come back are you also saying that they tend to go into non-academic posts?

(*Dr Freeman*) There is a grey area of academic posts. For instance, I am a great supporter of the Royal Society Senior Fellowship Scheme and the Wellcome Fellowship Scheme. These are people who frequently take positions with university departments. Part of the scheme is that they are not required to do teaching. In practice many of them do a little bit of senior teaching as a favour to the

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[1] *Note by the witness:* For example, through building local networks enabling collaborative interactions between university groups, other research establishments and industry, and sharing access to research facilities.

[Chairman *contd.*]

department and also as a way of making contact with potential graduate students and so on. I do not know whether you would define that as an academic post or not. It is held within a university department for up to ten years, with the possibility of a permanent job at the end of it, but it is not a teaching job and they are not taking the load significantly off the lecturers who are the real academics within those departments.

1133. What I was trying to discover very simply is whether you were telling us that these senior posts being introduced by the Wellcome Trust and others, which are so advantageous, are deflecting good people from becoming full-time academics because that could have a bad effect in the long run particularly if second rate people are appointed to full-time academic posts and their deterrent effect on students whom they teach could be very marked, could it not?

(*Dr Freeman*) I understand your point but I think the contrary is true. I think those fellowships are able to bring at least a few people back to this country to do science in this country who would not come back otherwise. I know from talking to many colleagues that they would not come back to university jobs as currently structured.

1134. I understand that but I am thinking of the students because the problem is in part this question if you do not have good staff the effect on the students in front of them is not attractive. They do not come into science; they do not want to do research; their minds are not enlivened by the kind of teaching they get. At least that is the kind of thesis put in the SBS document.

(*Dr Freeman*) I think these people in the university departments are helping to enliven the departments and bring them back up—

1135. They have sufficient contact.

(*Dr Freeman*) They do have sufficient contact certainly.

Baroness Platt of Writtle

1136. I wanted to make a different point because it seems to me listening to all the people who come to see us on this subject, that everybody is saying what we need is more money and there are different ways of spending more money but it is, one has to say, taxpayers' money. The only way one can produce more money is by people paying higher taxes in some way. Surely that is dependant on a successful industry and a successful wealth-creating industry? I happen to be one of the graduates who most passionately wanted to go into industry. I did not want to stay in research in university, although I was offered research. Surely one wants the highest quality people not only to stay to teach the coming students but also to go into industry. Surely one needs to see that the brightest at teaching and the blue skies research that needs to go done in universities is one thing but you want some of the brightest also to go into industry and you want the inter-action.

(*Dr Freeman*) I am very keen not to leave the impression that I believe it is the sole job of the best people in universities to stay in academic careers. The pyramid structure I talked about is really only the inevitable consequence of what little career structure there is. Very often the best people do leave at various stages. It is not a simple question of saying the best should stay in and the rest should get out. Instead some of the best will want to stay in academic careers and some will want to leave to go to industry or other walks of life altogether. I think the point Professor Lamb made at the beginning about a science PhD being seen as a passport to all sorts of careers is an important one. After all, a PhD is a training in rigorous thought, project management, hard work; things that should stand you in good stead in many walks of life. I absolutely take your point and I do not want to leave you with the impression that I feel all the top quality people should be staying in academic life.

(*Professor Lamb*) We have thought about this quite a lot and I think, John Patrick, you want to talk about this inter-action with industry. May we follow that?

(*Professor Connerade*) The question of the inter-action between industry and universities is one, of course, we discuss a lot in SBS and I am not sure whether it does not also revolve around these questions of real cost which were brought up in the earlier discussion. Certainly it is true that it would be very advantageous to the universities if they could judge the real cost of research from all industries but I think one has to be realistic about the different kinds of industry one is dealing with. We should not consider industry just as a monolith because there are so many different categories of companies one is dealing with. Some of them, like the large pharmaceuticals, can certainly afford the full cost of research. We are also dealing with large numbers of small companies, some of which have sprung up from within universities, spin-off companies, of which there are quite a considerable number, which are very small in size and cannot really afford these full costs. If we try to charge full costs we would be frightening them off the campus and I do not think that would be a good thing to do because it is, in fact, the most dynamic sector of industry, the one where small companies are bobbing up and down all the time and this is where the growth may well occur. I think we would be doing not only a disservice to ourselves but perhaps to the nation if we were to actually pursue this policy blindly of trying to charge real cost every time. I have seen this happening within my own institution that a number of companies have moved away because it is cheaper for them to come back to us and say, "We will hire a few of your staff as consultants and they will come and do work in our place rather than pay these enormous overhead costs to come to the universities." Therefore the benefit of the contact between the universities and industry, which I think is a very important one and should be fostered, might be lost if one were to follow this policy too harshly.

Chairman

1137. This is in fact virtually a direction from the Higher Education Funding Council to recover this money. Are you saying that as a major benefit

[Chairman *contd.*]

accrues to small industry then somebody, the DTI perhaps, should come in and bear their part of that kind of cost on the general grounds of encouraging new developing industry?

(*Professor Connerade*) That is correct, my Lord. That is pretty well what I am saying. I would use international comparisons at this stage and point to the fact that in other parts of the European Union such policies are practised perhaps not always publicly but we know very well that it is going on in fact. In other countries there is a kind of hidden subsidy. There is no level playing field, I think, if we practise these policies in too a rigorous fashion.

(*Professor Lamb*) If I may reply to the first point Baroness Platt raised about taxpayers' money and the costs of universities. What I think would be very useful is if the Treasury would get away from the idea that investment is the same as current account spending.

Baroness Platt of Writtle

1138. I quite agree!

(*Professor Lamb*) We would regard investment in the universities and the training of PhDs as a public good for the country. It might almost be a zero sum game in the sense that as we get wealthier it would pay for itself. I and others have entirely failed to move the Treasury on this matter. It seems to us they live in a world of their own. It would be very helpful if you could apply a little pressure.

1139. In a way what you are saying is something this Committee has said on another occasion, that you need long-term investment and the Treasury works on an annual basis and you want the Treasury to be thinking in terms of future wealth creation which does include investment.

(*Professor Lamb*) They should read Will Hutton in *The Guardian* yesterday. He has a nice model for the Treasury.

Chairman] We are not here to have evidence on the value of different newspapers.

Lord Howie of Troon

1140. This is the third time I have been asked to read Will Hutton in the last few days. If I could find £20 I would buy his book. I would like to agree very strongly with what you have said about the full costs. Industry does not carry on in that matter. It pays costs and allocates its overheads as it thinks appropriate and universities carry on in the same way. That is by the way. I would like you to explain to me what you mean by your paragraph 17 on page three. You are asking for a transitional salary to be paid by a potential employer. I wonder what you mean by potential employer. Do you expect the OST and DTI to put the money up?

(*Dr Mulvey*) My Lord, I can answer the first question perhaps in the following way, this is not a suggestion completely out of a vacuum. There are similar activities in countries like Germany where they have a somewhat different structure but it includes the Fraunhofer Institutions where people can move out into jobs in industry especially to help small firms. In West Germany, they ran a programme for five or six years in which the government put in 50 per cent of the costs of the salary of a qualified research scientist or engineer to work in a small company. They did this to help stimulate smaller companies to start doing R&D and innovation and start to employ engineers and scientists. They claim it worked very well indeed. Indeed they have just resurrected that same scheme in order to assist industry in East Germany to establish R&D activities. We are saying that in a transitional stage, when people are moving out of universities and looking for possibilities in industry for employment, that the state should help financially, by sharing some of the costs of the company, particularly a small company, to take these people into employment and start research. A survey done by a group in Warwick shows a relatively small proportion of the companies in this country, especially the smaller ones, actually engage in anything that could be called research and innovation. This would be a useful stimulant. If you ask do we expect the OST and DTI to pay for this, on current thinking we do not expect it!

1141. How does it actually work? Does one of your researchers looking for a job, apply for a job and when he goes along to the interview he says to the prospective employer, "I have in my pocket half my salary." I do not imagine that is how it works.

(*Dr Mulvey*) I am sorry to say, my Lord, that I do not have a detailed understanding of how it works. I suspect that it works at least in part through the institution, the university or the Fraunhofer Institute (which does already have contacts with quite a wide range of companies) and it is through those contacts that perhaps things like this get initiated.

1142. There is a form of networking?

(*Dr Mulvey*) I would assume that that must play a big part in it, yes.

1143. So that you might be head hunted, as it were?

(*Dr Mulvey*) There are a combination of different ways.

Lord Phillips of Ellesmere

1144. It is my understanding that the German scheme, as it is described in paragraph 94 of your paper, which I thoroughly approve, actually ran foul of European Union rules?

(*Dr Mulvey*) I believe they had a bit of a problem, but having stopped it they are quietly starting it again.

1145. It is the "quietly starting it again" that is important. The second point to make is that although Fraunhofer Institutes are often much talked about, and this is your paragraph 93, and we went through a big discussion of those a year or so ago, there was quite a strong current of feeling in Germany amongst people involved that our teaching company system was actually a better basis than the Fraunhofer Institutes?

(*Dr Mulvey*) Yes. The teaching company scheme is more at the undergraduate and beginning stage of research. In an earlier document we have actually said that it should be extended to the more senior level so we take in people who have already done,

[Lord Phillips of Ellesmere *contd.*]

say, two or three or more short-term contracts and are at an age of 30/35 or more. I do not believe the teaching company scheme usually operates in that area, but I may be quite wrong.

1146. I think you are right that it operates at a PhD level but supported by the strength of the research department behind them?

(*Dr Mulvey*) Yes.

(*Professor Connerade*) My Lord, I thought I might make a point about the Fraunhofer Gesellschaften. It depends whom you talk to whether you get a positive response about it or not. One advantage that I have heard cited in Germany is that it can act as a front for an industry, so that it may get involved in a piece of research without it necessarily being known outside who is involved. If I might explain what I mean. Siemens, for example, might be contributing through the Fraunhofer Gesellschaften to research in a particular laboratory in Berlin. It is then not on paper and the Government cannot use it as an argument. It cannot be used by competitors as an argument. They cannot guess what kind of research this is, and this has been given to me quite often as a good reason for having an institution of this kind which is a kind of neutral territory between the university and the industry. There are many cases where industries do not actually want to be directly involved with a particular laboratory.

Chairman

1147. Of course, this matter relates to a difference which has been highlighted between Britain and Germany, namely that Germany from 1812 onwards when the New University of Berlin was founded had this notion of joint appointments between industry and universities which made that boundary more permeable than the movement in either direction. We have not yet, it seems to me, at any rate, achieved that. One would hope that this could be developed. I got the impression from other parts of your paper that you felt that British industry was not in a sense spending enough on research, and if it was spending on development it was not enough on both of them together and was using the universities as a source of cheap effective research without being properly linked with the universities. Is that the case?

(*Dr Mulvey*) Yes. I think we were making the point that the trend at the moment seems to be one in which there would be more of that. I think you mentioned yourself earlier this morning the increasing degree of out-sourcing that is going on. We drew attention to that partly in connection with the problem of the short-term contracts which we have already been referring to, exacerbating that problem and making it even more necessary that some structures be put in place so that we do properly manage these short-term contracts, otherwise perhaps it will become increasingly a disincentive for people to enter the short contract system.

1148. Is it not worse than that in that the greater the extent to which universities move to applied research and the limited amount of money, the more they are going to squeeze out what the government wants them to do, as I understand it from *Realising Our Potential*, which is to stick to the last of basic research?

(*Dr Mulvey*) Yes, indeed. I think this is another point related to the career structure. In terms of academic careers, which is the focus of your inquiry, we think it is really essential to be attractive to some of the best, not all of the best. They must see an opportunity for using their own imagination, for following their own choice of directions in science without always having to work on contract research which, however interesting it very often is, nevertheless is limiting. One of the disincentives to an academic career is that with the squeeze on the funding council money in particular there is really very little flexibility for the exercise of initiative locally in the universities. That also connects, at least in my view, with industry because we would like to see people in industry, especially small, local companies, more freely able to go and discuss with university scientists and engineers the possibilities of doing something together without having immediately to address the question, "Where is the money going to come from?" There needs to be a flexibility of resource in the universities so that they have adequate freedom to initiate research.

1149. Are you concerned that with the present arrangements as they affect individuals on such short-term contracts and with the uncertainty as to the future you are not getting proper value out of the actual period spent in holding a contract appointment of this kind either in terms of quality of work done or in terms of quantity?

(*Dr Freeman*) In my telephone calls that I made last week that was a point that was made to me without my prompting by several people: that the standard three-year contract was incredibly inefficient because a large proportion of that three years is spent job hunting. Furthermore, if someone leaves halfway through that contract there is really no hope of replacing someone for a year of so of a contract. Altogether this seems an inefficient way of running long-term, important research projects.

Lord Phillips of Ellesmere

1150. My Lord Chairman, is this not again a question of management in large part? A lot of the conversations that we hear assumes that these contract research workers, so-called, are independent, solitary individuals working almost in a vacuum. Many of them work in well-organised laboratories, in research groups led by distinguished scientists, let us say, who know how to manage research. These people do not leave their young people alone in planning out the next contract or the next period of their work and so on, for example, in the laboratory in which you now work, do they?

(*Dr Freeman*) Absolutely. In the best examples that is true and where you have got a big thriving department there is a lot of scope for new contracts coming in, new grants coming in, but it is also clearly the case that there is a large number of people out there who are stuck looking for a new job in a new institution at the end of their contract, and with the best will in the world their current supervisor has only a certain amount of ability and interest in trying

[Lord Phillips of Ellesmere *contd.*]

to help them do that. They will write them references and so on, but the buck stops with the person whose job it is.

1151. They probably in general have a great interest in keeping them?

(*Dr Freeman*) Absolutely, if they can, but frequently they cannot. It is interesting that colleagues of mine who have advertised for postdoctoral fellows tend to get an enormous number of applications from a very wide range of people who are only marginally qualified for the job as advertised, and who clearly represent quite a large pool of dispossessed scientists. It seems to me that within the 42 per cent of university staff currently employed on short-term contracts there is a fairly large group of people who really do have the problems that we have discussed. Of course, in the best laboratories and the best managed laboratories that is less of a problem.

1152. Does this not bring us back to the sort of scheme that operates at University College London where people have to be given career advice?

(*Dr Freeman*) Which I would support wholeheartedly.

1153. I would suggest that that advice needs to come from the central university as well as from the department because the department has, as you have just agreed, a vested interest often in keeping these people on.

(*Dr Freeman*) I wholeheartedly support the UCL scheme and I think it is exactly the sort of move that other universities ought to be taking part in and considering.

Lord Craig of Radley

1154. When we were in the States we heard a certain amount about the exploitation of IPR (intellectual property rights) and I had wondered whether SBS had a particular view about this because it seems to me that it can be exploited more fully with the funding and in meeting the overheads an so on. I wondered whether any of you would like to comment on that?

(*Professor Connerade*) I certainly can comment on it. Universities are actually better organised than one might suspect and many of them have set up companies precisely for this purpose. For example, at Imperial College there is the IMPEL company.

Chairman

1155. IMPEL?

(*Professor Connerade*) It is a company which exists specifically to exploit intellectual property rights and investigates what research is going on on the campus and among this research what would be patentable. I think quite a number of universities are doing this kind of thing and there is a great deal of awareness of it. I do not think this is a question of cost-effectiveness.

(*Dr Freeman*) I think it is true that people are now aware of the importance of exploiting intellectual property rights. I suspect that it is being done in many cases in a rather amateur way still and I think that it is probably the case that one of the things that this country does least well is to take the innovative ideas that definitely are there within universities and take them to the next stage of development. Although I am sure we are moving in the right direction, I think we still have quite a long way to go.

(*Professor Connerade*) Perhaps I might add that this aspect that Matthew has just raised is a very important one in terms of cost. It is very unusual, except perhaps in the pharmaceutical area, that one can take a patent out directly after an invention. Most of the time one has to spend an awful lot of money on the development and that may be a hundred times more than on the actual funding of the invention or discovery. Perhaps the university stage is not the best one at which such patents could be taken out.

Lord Craig of Radley

1156. Your paper makes a great deal about the need for increased funds. I am not sure that the taxpayer is actually going to be able to help that much. I was trying to test your thinking on this particular issue and your comments.

(*Dr Freeman*) I think academics now are aware of IPR in a way that perhaps they were not ten years ago or 20 years ago. Certainly amongst the people that I see and talk to a lot of them are involved in various aspects of trying to patent discoveries and innovations that they have been responsible for.

1157. I hope you would agree then the role of SBS in pushing this is an important one?

(*Dr Freeman*) Certainly. We think that the problem lies largely within UK industry which does not have a good record of developing products from basic research. The role of the universities is presumably, you would agree, to do the basic research that leads to innovation that may then be developed. I think industry also has to share the responsibility.

1158. Perhaps on a partnership basis rather than somebody else?

(*Dr Freeman*) Certainly.

(*Dr Mulvey*) I think also it is very important to remember that a balance should be kept in this. I would like to go back to a remark which I think you made earlier that we must be very careful we do not push the thing so far that the main effort in universities and in research departments is going into finding more money from more contracts from industry and devoting less time and thought into work which is genuinely advancing the frontiers of science. I think one of the dangers we now face is a loss of this balance. Everybody agrees we must have better and more effective inter-action between universities and industry but wealth creation is the responsibility of industry and we are not sure, that industry really understands the amount of effort it has to put in to take advantage of the interaction with universities. If we take things too far we shall spoil the universities in doing the job they are there to do which is to advance knowledge and train people.

(*Professor Lamb*) One of the career structure problems that we have looked into is this; there are

[Lord Craig of Radley *contd.*]

at the moment many people with PhDs going round, the "gypsies" you talked about in the USA are found here also. British industry is almost unique in not having any scientists in its upper reaches. It has practically no scientists on its main boards and few engineers, which is unlike other European and Japanese companies. One of the career structure organisations we have discussed is how to get well-trained people in their 30s to move into management in industry. This is where I had in mind the Forces system where, as I understand it, if a person has not reached a certain rank by a certain age he has to leave the Forces and can be retrained to go into management. I would think the universities ought to think about this.

Chairman

1159. Thank you very much. I got the feeling that your general view is that we are in a situation where this state of affairs is bound to continue for some time. It is not going to be easily solved. We shall have a lot of contract researchers around. You feel they are not well managed. You also feel, as I understand it, money is so tight it is very difficult for new people on the academic ladder to get the degree of freedom and resources they need so that the young creative people can contribute the new ideas upon which we are powerfully dependent for the future. Have I represented your views correctly?

(*Professor Lamb*) Yes.

1160. I wonder if there are any other points we have not covered which you would like to represent to us in one minute, the alternative being to write in.

(*Professor Lamb*) Peter has not said anything.

1161. It is not a question of people being heard or not but whether they have got something to say!

(*Professor Saunders*) I hope, my Lord that I do. We have talked about careers and concentrated mostly on people in short-term contracts. It seems to me one place where the universities have really failed is with people who now hold tenured, or indefinite appointments, who are perhaps in their 40s and for one reason or another are dissatisfied or would like to try something new. It is not made easy for these people to do it in the sense there are no career advisory facilities within the universities. There does not seem to be much of a link with industry or anyone else in helping these people to move. Some of them are quite good. One can think of some very distinguished academics who have moved out. I was particularly struck by this because many universities have recently been being trying to reduce their staffing under some pressure. They have done this (through PRCS early retirement) which is extremely expensive; you have to buy extra pension rights and all the rest of it. During this process it was a matter of some frustration to me because I thought if you want someone to move out and you want to help them there is an employment agency cost. There is also a possible cost in transferring the pensions and perhaps smoothing the salary differential and all the rest of it as you move. But it seems to me that is a great deal less than universities have been willing to pay out to enhance the pension. From the standpoint of the nation you are then not losing an intellectual resource. It seems rather silly to retire someone to do nothing but gardening. In looking at the question of careers I do not think you can have a really good career structure if once people get jobs they automatically stay. If they do not want to stay I think we should looking at measures to encourage them not to.

1162. To make your point, those have to be measures in which the person's actual creative ability is given expression in a useful way.

(*Professor Saunders*) Of course.

(*Dr Freeman*) My Lord Chairman, may I just add one point to that by making a comparison between the two sides of the Atlantic? I think one of the elements that makes the universities' departments in America feel more thriving and less, frankly, stagnant is that there is a great deal more mobility at all levels in the system. That may be partly a function of the size of the academic system in America, but it also may be that there is more of a presumption that academics will end up with tenured jobs and having got a tenure job in one university the person will then get a tenured position in another. In this country such positions are so few and far between that there is a huge disincentive to moving once you have one. I think that leads to a rather damaging stagnation within departments, and that anything that could be done to encourage mobility both between the university and industry sectors but also within the academic sector between institutions at all levels of careers and not just at the lower level would be of huge benefit to the universities.

Chairman] Thank you all very much indeed for those remarks.

TUESDAY 9 MAY 1995

Present:

Craig of Radley, L.	Phillips of Ellesmere, L.
Dainton, L. (Chairman)	Renwick, L.
Dixon-Smith, L.	———————
Haskel, L.	Platt of Writtle, B.

Memorandum by The Royal Society

1. We welcome the opportunity to submit evidence to this timely enquiry. Policy on career structure is central to the well-being of UK science and technology. The Science Base is currently undergoing a series of radical changes, and it is vital to reflect on how these will affect, and be affected by, the careers of those who work in the Science Base. The Science Base cannot hope to play its proper role in national life unless it is able to attract and retain the right calibre of staff.

2. We discussed career structure as a whole in our 1992 report *The future of the Science Base*. More recently, we have examined particular aspects in detail eg:

- A survey of former Royal Society University Research Fellows. The key objective of the scheme is to give high quality postdocs an opportunity to establish themselves in long-term academic or other research careers.
- On making scientific careers more attractive to women, see the statement of policy in regard to the Society's own schemes. We are constantly looking at ways of ensuring that no avoidable obstacles are placed in the way of career development: the new Dorothy Hodgkin Fellowships are a case in point.
- On the MRes, see the Society's statement on postgraduate education and training, especially sections 6 and 7.

We enclose copies of all these documents (*not printed*).

3. One of the key issues is that of providing sufficient security of employment to a proportion of the best researchers on short-term contracts. This involves extending the horizon of employment beyond the end of the current (typically 3-year) contract supporting a given researcher. Although individual grants and contracts may fluctuate, a successful department can attract a reasonably constant flow of external funding. Where researchers have established their capabilities over say 5–10 years of external funding, a successful department can therefore, without undue risk, offer a certain number of them long-term appointments similar to normal HEFC-funded academic staff but supported mainly if not entirely on external funds. The selection of research staff to whom the university would make a long-term commitment should be as rigorous as that used in appointing to normal academic posts. This is the essence of the UCL proposal, which we commend.

4. Technical obstacles to this approach arise from the dual support transfer, as a result of which the overheads payable on a research grant are calculated as a percentage of the salary costs of short-term staff employed on the project. This provides a powerful incentive to recruit short-term staff, thus exacerbating one of the main problems of concern to the Select Committee. At the least, granting agencies would need to accept that the time spent by permanent, non HEFC-funded research staff on their projects could attract the 40 per cent overhead payment.

5. Many policy initiatives focus, rightly, on ways of nurturing the careers of high-fliers. But progress in science depends on many differently skilled people. Those who have not demonstrated a particular aptitude for original or independent research may still make an important contribution. This is the cohort that we described as "Research Officers" in *The future of the Science Base:* competent postdoctoral scientists occupying a niche between technicians and principal investigators.

6. The efficient conduct of research requires teams made up of appropriate proportions of research leaders, research officers and technicians. Research officers are to some extent generalists, able with occasional retraining to move between a variety of projects within a fairly broad field. Departments securing a steady flow of project grants should therefore be able to take onto their permanent establishment a substantial proportion of the research officers needed at any one time, even though such staff would be paid from project income rather than from core funding. This would reduce the disruption of recruiting staff specifically for each project and provide an attractive career structure with assurance of continuity to scientists at this level.

7. Our third recommendation concerns responsibility for career development. All too often, researchers on short-term contracts are left to look after their own careers with little formal guidance from the institutions in which they work. These institutions have the main responsibility for appraising the future potential of individual staff and, in particular, identifying early those for whom no long-term academic career is likely to be forthcoming. Such staff should be encouraged to explore other career options and should be given every

opportunity to acquire skills that can be transferred to other sectors. It is common practice in academic engineering to acquire experience outside academe early in one's career. Given that many more people enter on the first (postdoctoral) steps of an academic career than can be accommodated in the subsequent stages, and given the value to other sectors of employment of the skills they acquire, it is essential that there should be recognised an honourable exit mechanism at every stage. Explicit provision should be made for the costs of appraisal and training, either from project budgets or from general university funds.

8. Our fourth recommendation, relevant to those who take career breaks for family or other reasons, is that it should become normal practice, when defining criteria for appointments or funding, to think in terms of career stage (eg years of full-time research post PhD) as well as age.

9. Increased movement of staff, temporary or long-term, between academe and other sectors of employment is valuable to both sides of the exchange. There can be considerable practical difficulties, but initiatives to facilitate interchange should be encouraged.

10. The growth of academic staff on short-term contracts is directly related to the continuous rapid growth of external, short-term funding of research from a variety of sources. The latter, and therefore also the former, seems set to continue. A diversity of career paths will be needed to respond to the diversity of skills and opportunities. Institutions such as Warwick and UCL are beginning to experiment with non-traditional approaches to career structure: such experiments should be encouraged. Our recommendations identify ways in which positive progress can be made. But the bulk of such staff should be mobile over a proportion of their careers, few staying very long in such a role.

Examination of Witnesses

PROFESSOR J H HORLOCK FENG, Treasurer, PROFESSOR P J LACHMANN, Biological Secretary, and PROFESSOR NANCY ROTHWELL, Professor of Neuroscience, Department of Physiological Sciences, University of Manchester, the Royal Society, called in and examined.

Chairman

1163. Thank you all for coming. I think you know pretty clearly what we are about because you have had a series of questions sent to the Royal Society some time ago and you have also sent us a memorandum. Is there anything which you would like to say by way of introduction, any one or all three of you, to emphasise points in your memorandum or, alternatively, to add points which have been, as it were, lost sight of and you would like to put in now? There will be opportunities later. It is up to you.

(*Professor Horlock*) Perhaps I could mention one or two general points, my Lord Chairman, and then Professor Lachmann might explain the University Research Fellowship Scheme, which he operates. Professor Rothwell is the ultimate example of the University Research Fellowship Scheme which she has come through to a chair appointment. There are two or three points we brought out in the paper. I think the first one is that we feel that the career advice is important and we emphasise that, and you will see the supplementary paper from the CVCP which develops that. I think the second point I would wish to make, as an engineer, is that there are other options in life to a research career in universities, and as far as engineers are concerned, we expect them to move backwards and forwards between academia and industry. I remember when I was a research student in Cambridge that Lord Baker refused to accept anybody as a research student unless they had been in industry, so one had to go away and then come back again, and I think that perhaps we have lost a little bit of that. I think the third main point which we would wish to emphasise is that there must be provision for the very best research workers to come through to academic appointments in due course, and Professor Lachmann will amplify that, with the URF Scheme. I think we would add that there has to be coupled to that a funding relationship and we are very pleased with the schemes which are operating at University College London and Warwick now where obviously the university has taken a decision to fund a small number of permanent research appointments. People can come through to there so they have an objective to work towards. How this is done is a matter for discussion and development, I think. The fact that it has been done at UCL and Warwick is perhaps a reflection that they are major research universities and decisions have been made to make provision for a certain amount of funding for those posts—I think that this is an important initiative. The other option of course is that if you have a big university research department with a lot of project funding coming in, you can take a chance of appointing somebody to a permanent post on the assumption that there will continue to be a stream of project money coming in. We have certainly done that in engineering for years in relation to technician appointments and one can see big departments being able to do that for research officers and for these senior research workers, but I think Professor Lachmann would wish to develop the point about research officers. So I think those are the main points that I would pick out from our paper, my Lord Chairman, but I would hope that you would hear from Professor Lachmann about the URF Scheme.

1164. We will when we have asked you questions on what you have just said and particularly the last point because I noticed in your paper it was made very strongly that if the department is large enough in its research activity, then in a sense it has enough of a cushion in a large sum of funds to be able to carry people over at least in bridging grants from one to another and have developed a policy, and one understands that, but what you do not say anything about is what the fate of staff is in departments where

[Chairman *contd.*]

equally good work is done which has a lower research income and yet they contain a powerful and innovative group of young people. What is to happen to people of that sort in your scheme of things or let me put it another way round and ask are we not now up against the question of choosing the locations for research even more sharply than has been happening in the past and does it mean, for example, that research will tend to be concentrated in, and I use the common adjective now, the "Russell" universities?

(*Professor Horlock*) I think that is one point. That undoubtedly will tend to happen and perhaps one has seen some evidence of it already in the Warwick scheme, I think. On the other hand, I suppose if one is talking about a department that is not a small department which the university wishes to encourage, then I would say it is up to the vice chancellor to take the initiative and see if he can divert funds from overall university funds in that direction to provide some support.

1165. How does the Royal Society regard what we are told are activities when we were in Scotland of some new universities actually buying in research teams? Do you regard that as a good thing or ultimately leading to a dilution of activities, a dilution of funding to an ineffective level?

(*Professor Horlock*) I think with some concern—we would wish to continue to watch this. The thing that one is buying in of course is not only the salary of the young professor, certainly in the physical sciences and I imagine biological sciences as well, but one has got to provide the infrastructure and the back-up so that is a great deal of money. I am puzzled, as a former vice chancellor to know how they are finding the money for this because in most of these universities where it is being done, they have very heavy teaching loads and I do not know how they have been able to divert money across, but we shall watch it with interest.

1166. But then of course there is a built-in incentive financially to have the research activity well regarded because the Funding Council rewards you, so I suppose they are calculating on that, whereas in teaching they are not at all rewarded on the quality in England, though they are in Scotland.

(*Professor Horlock*) You still have to find the money up front to do this operation for some years before the money comes in from the Funding Council subsequently.

1167. Surely, but it does seem rather haphazard to leave major questions of policy, does it not, to the accidental intervention of university, funding formulae and things of that kind, particularly as funding formulae are different in Scotland and England?

(*Professor Horlock*) Yes.

1168. It shows a degree of indecision amongst the policy-makers, would you not think?

(*Professor Horlock*) Yes, I think on a personal basis I would agree.

1169. Professor Lachmann?

(*Professor Lachmann*) I think this is an example of the spread of perverse incentives (with which we are very well familiar with in the Health Service) spreading to the education system. I do not think the HEFC exercise was actually intended to produce this form of response from the vice chancellors of new universities, but undoubtedly it is a perverse incentive that they should buy in people with research records which may raise their HEFC rating on or before the critical vesting date for the new exercise. This is not planning of research, but an attempt to raise their HEFCE rating and their research income. If successful, these manoeuvres will move funds in the opposite direction from that of the concentrating research in the Russell universities or centres of excellence, or whatever they are to be called and lead to a wider dissemination of HEFC funds. Therefore, movements of funds in both directions will be seen and the result of the next HEFC exercise may be quite unpredictable.

1170. Does this cause you concern in the Royal Society?

(*Professor Lachmann*) I think perverse incentives do give us concern. They introduce irrelevant considerations into the conduct of research and, as we are going to discuss later, irrelevant criteria for discrimination is something the Royal Society wishes to avoid. The Society tries to concentrate on excellence of quality and motivation and not on a variety of perverse incentives.

1171. Given this attitude, are you contributing your views to the Committee of Vice Chancellors and the research councils' discussions over trying to get something well arranged for these contract research staff?

(*Professor Lachmann*) We are party to the concordat.

1172. You are party to it?

(*Professor Lachmann*) Yes.

1173. Can you tell us when it is likely to report on what progress has been made?

(*Professor Lachmann*) There have been several versions circulated. I have the latest draft which is being discussed. Professor Horlock may know more, but I have no idea when the final draft will be ready.

(*Professor Horlock*) We are having a number of informal discussions with the HEFC and the research councils over the next few weeks.

1174. But the final draft is not yet with you?

(*Professor Horlock*) I do not think so, no. Have you seen the earlier drafts?

1175. No. We have not asked for them at all. It would seem to me improper to ask for working papers before you come to final conclusions. Professor Lachmann, you were wanting to say something.

(*Professor Lachmann*) I would like to respond to your first question about the Royal Society's Research Fellowship Scheme. This is now the Society's major programme of research support and you asked how successful it has been. The Royal Society is, I believe, well pleased with it. Fellows have been appointed to the school in its present form since 1983 (though related schemes go back much further) and there are now going to be about 250 fellows in post: a rapid expansion in number. The scheme aims to solve the problems of those who have completed PhDs and one period of postdoctoral training and

[Chairman *contd.*]

then require the opportunity to establish themselves as successful academic research workers; as a result of which the society expects and hopes that most of them will then find established posts in British universities. We believe that the scheme is successful in recruiting very high-calibre research scientists. A lot of effort goes into the selection process and there are a large number of applicants covering the whole of natural science. While there are somewhat comparable fellowship schemes in the biomedical sciences run by the Lister Institute, the Wellcome Trust and the Bect Memorial Trust, in many other areas of science the opportunity to get such long-term support is much more limited. The scheme supports a fellow for up to ten years. It includes quite generous research support which fellows are encouraged to supplement from research council or charitable sources, and the Royal Society does its best to make sure that its URFs are not "exploited" by their universities into undertaking work which the Royal Society thinks incompatible with the whole-time pursuit of research. Fellows are not discouraged from doing some teaching or doing some other academic activities, but we do keep a careful eye on such activities and feel, as the funding body, that we have a right to protect our fellows from undue pressure from the outside world. On the whole, the URFs have done very well. The figures I have are reasonably up to date, and show that of 141 who have left the URF Scheme since 1983, 103 (or 73 per cent) are in posts in United Kingdom universities, 3 (or 2 per cent) are in posts with research councils, 15 (or 11 per cent) are in posts abroad, 9 (or 6 per cent) are in industry, and 14 (or 10 per cent) are doing other things. Some of the last group have gone into journalism and others into hospital work and two have died. There are very few who have failed to obtain posts; and of the 30 further fellows who we know are going to leave their posts shortly, nearly all are going into posts in United Kingdom universities.

Lord Craig of Radley

1176. Those are very interesting figures and thank you very much for them. Could I look to the future and ask you whether you believe that you should be increasing the number of your research fellowships and, if you do or if you decide that you should do, what would the consequences be? What penalties, in other words, would you have to accept in order to increase the number of fellowships that you offer?

(*Professor Lachmann*) I think we are now probably approaching some sort of steady state where we hope to be electing between 50 and 60 fellows a year. The "penalty", as you say, is that we must make sure that there are enough opportunities for the fellows to go to when they finish. We believe our university research fellows to be *la crème de la crème*, and it would be a pity if there were not enough posts for them in the UK and large numbers of them were forced to go abroad. The long-term future for professional research workers in the United Kingdom is a matter of concern to the Royal Society. In the short term, when the "Robbins bulge" begins to retire at the beginning of the next millennium, there will be corresponding "bulge" in new appointments becoming available. However one really does not want "bulges" of this kind because the same problem then recurs in future and a smooth increase in appointments is preferable. There will be new appointments in the new universities, particularly in some branches of science, who are, as already discussed, keen on increasing their research effort and providing they can find the funds to do so.

Chairman

1177. May I just interrupt you because I can see your concern is with quality in the Royal Society, and you have mentioned the numbers that you have, but we have to set that against the fact that there are close on 22,000 of these people in universities now, so to what fate are you consigning the 21,000 with whom you have little contact, if any? Do you have no interest, yet they are of course absolutely essential, many of them, to the work in research that goes on?

(*Professor Lachmann*) Indeed, my Lord Chairman, and I hope to come to that later because I have a great interest in research officers.

1178. Would you like just to answer me briefly now?

(*Professor Lachmann*) Can I just say that the research effort requires, if I may use such a politically incorrect phrase, both "Chiefs" and "Indians". We regard our URFs as potential Chiefs who will lead in due course their own teams, but we are very well aware of the fact that you cannot have a successful research effort without a substantial army of "Indians" and we are very concerned that the large numbers who fill this role have not been given a good deal with regards to any form of security of employment, security of tenure, a decent pension structure, and that some injustice is done and it may be difficult to maintain a good quality effort if one does not take this into account, and we have watched with great interest the proposals being made—

Chairman] I must interrupt you because it is for us to ask you the questions and Lord Craig wants to ask you one.

Lord Craig of Radley

1179. You talk about chiefs and indians and you have taken the view of around about 60 or so per year as the intake. What I am trying to get a feel for is how you have arrived at that view, bearing in mind, as the Lord Chairman said, that there are very, very large numbers involved across the whole sphere of research science.

(*Professor Lachmann*) My Lord, in all honesty I think we reached that figure in large part because that is the amount of money that the OST has made available to us for this scheme.

1180. Which is where I came in with my penalty question.

(*Professor Lachmann*) OST have been giving the Society more means to increase URF numbers, but we are now reaching the stage where the question is being raised whether a further increase in the URF numbers should continue to be the Society's highest priority or whether other forms of research support

[Lord Craig of Radley *contd.*]

should now be given equal weight. There are other fellowship schemes available.

Chairman

1181. Well, we have had evidence from the Wellcome Trust, for example. May I just ask you a question? Is this data to which you refer all incorporated in this document?

(*Professor Lachmann*) No, my Lord Chairman. The figures I gave you are still in draft and were given to me this morning.

1182. Would you be prepared to submit those to us?

(*Professor Lachmann*) Yes. I will either leave this draft with you or perhaps it might be better if you had a redrafted copy in the next day or two which may be more legible.

1183. That would be helpful. Thank you very much indeed.

(*Professor Horlock*) What I would feel, my Lord Chairman, is that we could go a bit further on the URF Scheme. I would like to see it probably go up to 400 or 450 from, where are we now, 300?

(*Professor Lachmann*) No, we have 200 plus.

(*Professor Horlock*) I think I would couple it with the suggestion that they might find other careers than in the universities. I am a little disappointed, for instance, that the figures for industrial appointments are quite low, the percentage is low, and I am astonished that British industry is not going and looking around at this marvellous corps of research workers and trying to get hold of them. Quite frankly, they really are the best in the country and one would expect people to be looking for them and buying them up as much as possible.

1184. This is a great source of concern to us of course because there are so many of these people and indeed many of the so-called indians would be invaluable to industry too, so has the Royal Society got any views about the interdigitation of university research and industrial research and any better mechanisms? In particular, what do you think about the LINK scheme in its modified form and the other schemes which exist?

(*Professor Horlock*) We would commend them. We also have our own industrial fellowships of course. The recruitment to those I think, Professor Lachmann, has been improving, has it not, over the last few years fairly considerably? At the same time perhaps we should advertise our wares more and the success of the University Research Fellowship Scheme.

1185. Professor Rothwell, would you like to add something?

(*Professor Rothwell*) My Lord Chairman, could I just raise a brief point about industry? My experience from my own career and the other university research fellows in the Royal Society scheme is that they are fairly sought after by industry, but many of them wish to stay in academic research institutes and I think that may be a feature of many people who go into this scheme. A brief point relating to the discussion earlier about the URF Scheme in relation to other schemes; as far as I am aware this is unique in that the URF Scheme funds the person, the scientist, whereas many of the other schemes fund the science project together with the scientist and if that specific science project does not meet the levels necessary for funding, then the scientist will not be funded. The Royal Society tends to take a rather different view, that we will fund whoever we think are the best scientists and leave them to get on with whatever research they see fit.

1186. This is fine if you are operating from the quality end, but it could be said that no system, however bad, can possibly ruin those people and that they will get through anyway.

(*Professor Rothwell*) You have to select the right ones.

1187. One can accept of course that by providing these scholarships, you have enabled some people not to be lost to the system and particularly to the basic research end in which the Royal Society is primarily interested, but there are all these other contract research staff who have a great deal to offer to industry and to other activities outside the universities as well as within the universities. Has the Royal Society got any views on those who constitute the main preoccupation? You did refer to the fact that some of them are treated unjustly, I think would not be too strong a term to apply, in the sense that age for age, qualification for qualification they are less well placed than are tenured staff, though one has to put quotation marks around "tenured" nowadays because that disappeared in the legal sense in universities. Have you got any views on those?

(*Professor Horlock*) I would say that I see the problem very acutely really, my Lord Chairman. I am concerned with your figure of 22,000. I am astonished it is so large.

1188. Yes.

(*Professor Horlock*) But at the same time I wonder how many of those research fellows, certainly in the engineering side, are people who might have been research students some years ago when research student stipends were better than they are at the present time. I see in the engineering side people being employed as research fellows, sometimes working for a PhD over an extended period; they become hopeful about getting university appointments, whereas they would not have done so if they had been research students working for three or four-year periods. So I am very much concerned, particularly in the engineering side, about the level of research student stipends and their inadequacy, which may be making this problem worse.

1189. I think it is, but for those who have less lofty eyes than you have in the Royal Society, there is the problem I think which has been represented to us many times that the mass of these people who, on the whole, are not particularly contented, to judge from our meetings with them, has a bad deterrent effect both on the quality of the research that is done and also on able people coming into being scientists, engineers or technologists. Has the Royal Society got any views on that?

(*Professor Lachmann*) I think, my Lord Chairman, the Royal Society views with great interest the experiment being undertaken in University College

[Chairman *contd.*]

London which addresses the problems of this group of workers and it is to be hoped that other institutions will follow Dr Derek Roberts' example and try and put together at least some form of bridging finance as a way of giving the contract research staff greater security. I personally regret that a "rubric" for tenure which, for example, the Medical Research Council used to have on its units has been discontinued. This allowed those who were not going to become teams leaders but who had skills which were of long-term value to the Council to be given a tenured appointment. I very much hope that funding bodies, the research councils, the charities and hopefully the universities, will all recognise that if they do not provide decent career prospects for these very valuable people who underpin research effort, (and I believe perhaps are found in larger numbers on the biological side) they will damage the research enterprise. I think it would be extremely helpful if the view was supported from "on high" that some form of structure is needed to provide career progression for those who are not necessarily going to end up as Nobel laureates or in the House of Lords, but who are nevertheless necessary for the furtherance of the scientific enterprise. In biomedicine there are opportunities for employment in the pharmaceutical and biotechnology industries, and that is to be encouraged. We hope that this traffic will go in both directions and I think that is occurring. To be anecdotal, I am involved in a joint enterprise between SmithKline Beecham and my MRC unit where we share projects and our individual skills and techniques, and where in the future people will move freely from one laboratory to the other. This is much easier in areas of science which are of interest to the pharmaceutical industry and also if the geography is favourable. The "Cambridge corridor" between Stevenage, Harlow and Cambridge now houses a great wealth of pharmaceutical research.

Lord Haskel

1190. I was interested in your comments about the relationship between these top-class scientists and industry and I was wondering whether you had come across the fact that industry takes the view that they would like a lot of these top-class scientists to set up their own laboratories so that they could then subcontract research work to them rather than the large companies taking these people on as employees and everything that that implies. Have you come across this view at all?

(*Professor Lachmann*) Yes, my Lord, indeed. The debate between "in-house" and "out-house" provision of research goes on vigorously and is influenced by the relative cost. This may be reduced by contracting with a small biotechnology company compared with having the expertise in-house. I think both arrangements will continue since there are advantages for both—for the companies and for the scientists. There has been an epidemic of new biotechnology companies, many of which have done extremely well and have been a great source of innovation and novelty. However, there is now great concern about the financial stability of this industry. There was an influential report by an American brokerage firm pointing out that there is not the venture capital available to keep the majority of biotechnology companies in business for another 18 months not just in this country but also in the States. That is a matter of great concern and some scientifically excellent companies may go out of business because the amount of money they now spend and the amount of venture capital which is available to support them are now getting out of balance. The financial attractiveness of setting up new companies in 1995 is not what it was in 1985.

Lord Phillips of Ellesmere

1191. Could I just intervene and say that in my experience the contagious quality of biotechnology is much higher in the United States than it is in the United Kingdom and when you say there is an epidemic of biotechnology companies, I bet you cannot actually name ten that are listed on the United Kingdom Stock Exchange yet and I doubt if you could name three that are profitable, so it is much more an American phenomenon than it is a United Kingdom phenomenon at this point.

(*Professor Lachmann*) I think that is true. I think I probably could name three which are quoted on the UK Stock Exchange, but most are quoted on the unlisted securities market or indeed on NASDAQ in America. As for profitability, I am sure you are right, that the venture capitalists support "gene dreams". Venture capital is easier to obtain before the company makes any product at all because then the potential upside has no limits once the company actually makes a product, an estimate of how much profit it is likely to make becomes possible.

Chairman] But the majority of these people who are in industry are not in these new venture capital companies, but they are in older established industries and it is there where the large number of possibilities for employment of these people are.

Lord Phillips of Ellesmere] My Lord Chairman, following up Lord Haskel's point, despite the enormous investment recently made by Glaxo at Stevenage, I think the outsourcing of industrial research, especially if we go out of pharmaceuticals into industry more widely, is becoming an extremely common phenomenon, and I am sure that many large industries see great advantages in getting various things done within the university system where they do not have to carry the overheads and so on, and this raises a big management problem for universities in relation to staff and in relation to managing a disparate flow of funding streams which they do not seem yet to be very good at.

Chairman

1192. Could we spend a little time following what Lord Phillips says on the problem which has been put before us very often which is this question of universities and overhead charges given that there is really a very competitive market for raising money from industry of course. There is a reluctance on the part of universities I think to make full cost charges to industry in order to secure, if you like, any tendering for money from industry for research

[Chairman *contd.*]

contracts. Ought something to be done about that? Ought the Government perhaps to recognise that this would be a valuable way of uniting universities and industry through research and help to pump-prime that outside the HEFC or the research councils? The DTI, should that do it?

(*Professor Horlock*) I always find this very puzzling, I think, my Lord Chairman, because I still work in the Whittle Laboratory in Cambridge which is largely financed by Rolls Royce. I have great difficulty when I go into that laboratory in knowing who works for Cambridge University and who works for Rolls Royce. There are people flowing backwards and forwards all the time. Professor Denton, for instance, at the present time is redesigning the fan on the Trent engine for Rolls Royce. The integration is absolute and I do not know quite how we achieved it—perhaps with some DTI support in the early days. But subsequently there was a recognition by Rolls Royce that they needed an academic research outpost which would integrate well with the company. How you spread that practice elsewhere, I do not know. You have to build it up over many years, I think.

1193. Though in some ways it is the industries who are not the Rolls Royces of the country and successful who most need this help. How do you get it to them?

(*Professor Rothwell*) Could I raise the point that stipulating overheads is something that is now required because universities are not charging for the work they do, but to enforce specific levels ignores the direct relationship between industry and universities and makes it very much just a business proposition, whereas the example which has just been given by Professor Horlock clearly identifies that there is much more than an exchange of money between the two and that is only when it works very well. So, for example, to charge a large overhead may be inappropriate when there is much more advantage to be gained from the university by industry.

Lord Phillips of Ellesmere

1194. Would you excuse me, Professor Rothwell, if I interrupt you to say that I really do wish the university people would get away from the concept of overheads and start talking about the full costs of the research that they do and learn to arrive at specific agreements with industry and then if industry does not want to pay the full costs of research, then it has to be for some such reason as it is a collaborative piece of work from which the university itself is deriving some benefit, but to talk in terms of arbitrary percentage figures for overheads I think is a ridiculous way of going about it.

(*Professor Rothwell*) I agree, and it is the way that most universities are still operating.

Chairman

1195. Is this not due to the fact that they are under some pressure from the Funding Council to do just that?

(*Professor Rothwell*) They are told to fix levels they should achieve.

1196. The Funding Council, having handed over money to the research councils, feels that the universities should provide for themselves the proper costs of the project, as Lord Phillips has said.

(*Professor Rothwell*) HEFC has just published the figures of percentage recovery and it is given in hard figures.

Lord Dixon-Smith

1197. What is now argued, as I recall, is the cultural distinction if there is one, and I really do not think there is one, but we are arguing a perceived cultural distinction between universities and business. They are both enterprises and they may have different forms of, shall we say, measuring their output, but in the end they have both got the same problems, which is to make the available money deal with the work that they want done. You will not argue against the fact that this system has built up because a large number of highly qualified people have had this ambition to move in academe which they perceive as being a more cosy environment than business and commerce and because that is so, the universities in a sense have been able to be irresponsible, and I use my words advisedly, in their approach to the whole thing to cash in on this perception and expand the research market in a way which otherwise would probably not have happened.

(*Professor Rothwell*) I feel that the universities have not entirely cashed in. The problem is that they do not cash in, that they do not charge realistic figures, that is the argument levelled at them anyway.

1198. If they were charging realistic levels, surely we would not be seeing outsourcing by industry into universities and it might well be the other way?

(*Professor Rothwell*) They might as well do it in-house then.

Chairman

1199. How far would you say that this is just a classical economic situation of an oversupply of contractors to do research?

(*Professor Rothwell*) That is probably quite a large part of it, an over-zealous response from the universities to attract funds.

1200. So whatever you may say about this does not remove from the universities the responsibility for being good employers not least because of, as we have mentioned before, the deterrent effect of a body of people who on the whole are not contented with their work and from whom the feedback is disadvantageous to science as a whole.

(*Professor Horlock*) I could perhaps say, my Lord Chairman, that the two industrial companies I am associated with have both begun to react against very large overheads being charged by two or three universities at the present time.

Lord Phillips of Ellesmere

1201. That takes us back again, Professor Horlock, to the arbitrariness of this percentage overhead problem. It needs much more careful contract negotiation surely.

(*Professor Lachmann*) I would like to take a slightly different view on this. I think that the non-transparency of what I will still call "overheads" is largely of the Government's own making. When they decided to give the overhead money to the research councils to ensure that the universities did not spend it on functions not related directly to research, they at the same time made non-transparent the overhead funds for other research, assuring the universities that it was still in the budget, but no longer separately identified. This overhead money is not for industrial collaboration, but for charitable grants. Grant money is now divided into research council money with which the university gets an overhead and charitable money for which the overhead, has to be met by the recipient—

1202. But, Professor Lachmann, you seem to be locked into this concept of overheads. The research councils now pay the full costs of research, except the cost of the premises and the academic staff involved. It is a full cost concept.

(*Professor Lachmann*) May I come back to what this amounts to? It is in most cases 40 per cent of the salary costs. What it may be spent on is an interesting question. Industry is normally charged a larger amount than this and although Lord Phillips speaks about the full cost of the research, that is actually an unquantifiable sum. In defining costs of research in Universities too narrowly there is a great danger of killing the goose that lays the golden egg. The universities are there to train the people who are going to do the research in future and the costs of this training also have to be found.

Chairman

1203. Is that not an argument for Lord Phillips saying that the negotiations should take place between the purchaser of the research and the researcher to arrive at something which each can find acceptable?

(*Professor Lachmann*) I think indeed that is probably more often than not what happens, but the universities must maintain university libraries, they must maintain their premises, they must maintain an adequate teaching culture to train the people who are going to do the research in the next generation and that is quite difficult to put into a calculation of what a particular piece of research would cost in-house or out-house. Whereas I am sure that some large and wealthy companies are well aware of these facts and that they are making a contribution to science in the next generation, short-termism is not confined to only government, and companies which are short of money will also be tempted to take the cheapest option. There is some considerable danger that we will not have available the resources to provide the next generation of research workers. To me, as indeed to you, my Lord Chairman, who have a lot to do with the National Health Service, the parallel with what has happened there and in the medical schools is quite striking. It is relatively easy to force down the prices of provision now, but we are all going to have to live with the consequences in due course.

1204. How far do you think in the Royal Society we are just living in a transitional period from one form of funding to another and that through experience a form of living together for funders and the contractors will in fact come about of its own natural accord and that, therefore, there is no need to make any recommendations at the moment, or do you think that this situation is so serious that perhaps some strong comments should be made on the desirability of getting the proper cost arrangements between the two parties well established and do that as soon as possible?

(*Professor Horlock*) Yes, I would welcome it if you did say that, my Lord Chairman. I am also taken with your point about whether the DTI could initiate the coming together of some university research groups and industry in the way I described in relation to Rolls Royce in Cambridge, but we have seen the DTI really withdrawing from the action in this area over the last two or three years and that is probably a matter of regret.

Baroness Platt of Writtle

1205. Will the Office of Science and Technology get into the field or do you think it is more unsolved with Technology Foresight?

(*Professor Horlock*) Perhaps so. We have not seen them yet picking up the kind of thing that DTI used to do in that respect.

Chairman

1206. It does seem rather odd, does it not, at least to me, that of the two planks of the White Paper, *Realising our Potential*, one of them was wealth creation and the other was quality of life of course, but if there are obstacles in the way of wealth creation for the universities, ought one not to try and remove them and that also makes for better relations with industry, does it not? Perhaps we ought to move on.

(*Professor Lachmann*) My Lord Chairman, I would just say that my own view is we are in a state of a continuous Maoist revolution with regard to all these matters and that there is at the moment no prospect of stability. I think it would undoubtedly be helpful, as Professor Horlock was saying, if some form of more stable regime were to emerge because I think any degree of long-term planning whether by universities or by charities is impossible because no-one knows what the rules are going to be tomorrow.

Lord Dixon-Smith

1207. It is a very interesting question, my Lord Chairman, but can you ever expect a period of stability at the same time as you are existing in a period of constant change and development? I think it is impossible.

(*Professor Lachmann*) I think you are right.

Chairman

1208. Because the powers of the individuals who are taking part have to be free to act in their own interest. Could we just summarise where we have got to with you now? I think you have given us some feeling that there is a problem here, that large universities can cope with it, including University College London and, as we discovered in Edinburgh, the University of Edinburgh and to a certain extent the Imperial College and that your view would be, despite your elitism, used in the best sense of that word, you are concerned about the indians, as you describe them, and that all the universities ought somehow to work out a system which ensures that the best work is got out of these people who are employed and that they are getting a fair deal, otherwise there would be great discontent and poor quality of work. Is that it, in short?

(*Professor Rothwell*) Can I just make a small addition, that not only will there be a loss of work, but we will lose these people in the long term, I feel. The level of feeling in young scientists at the moment is very worrying and they are very concerned about their future and this applies across the board, so it will be more than just a loss of the work, but it will be a long-term loss of young scientists going into careers.

1209. We did say of course that the quality suffers because when they are in post, the first year is spent largely settling in, in the second year they are worried about where they are going to be in the third and fourth year on the short-term contracts and that is presumably one of the reasons why you have gone for long-term contracts, but you have welcomed the long fellowships now, but they also say that the justification for further grants tends to be on publications as much by weight as by quality and that this creates a pressure to publish and that creates in turn pressure to engage upon publishable work, but which you know is publishable at the outset, but by definition is less speculative and less original and, therefore, the effect on even your kind of work could be damaging. Is that something which is felt?

(*Professor Lachmann*) I think that is so. I would add that the Royal Society is engaged in an investigation of peer review practices. There is also a sound economic argument for having longer grants. There are costs involved to the people who write the grant requests and are, therefore, not working; and costs to the people who read the grants and are therefore, not working, and to the administrators of the scheme. All of this is extremely expensive. In our view, the answer is not to dispense with the peer review but to have a longer granting period so that peer review is done less frequently.

1210. And would you say that done less frequently would probably be more careful too?

(*Professor Lachmann*) It may well be so.

(*Professor Horlock*) I would add to your summary, my Lord Chairman, the point I made about the relationship between the research student and the junior research fellow. Within the National Academies Policy Advisory Group, NAPAG, which we have set up, we have been discussing whether we should look at research student stipends. We have not yet agreed to do so, but I think in the light of your remarks, I would be inclined to advise NAPAG that they should also look at this interface between the research students and the younger research fellows.

1211. Could we just touch on the problem of women in this group of contract researchers because all that the figures show is that they are very markedly disadvantaged compared with men of the same academic age. I use the term "academic age" to make allowance for the fact that women may leave the profession for a period and then come in and they are chronologically older and quite understandably taking posts which are comparable with people who are male who are younger and who have not had a break because that is the way the universities work on the basis of appointing through experience and proving your record. Has the Royal Society got any views on this?

(*Professor Horlock*) Very strong views, my Lord Chairman. We have done, I think, three things, probably more, since the *Rising Tide* report. First of all, we have introduced a substantial degree of flexibility into the University Research Fellowship Scheme in which women may take a year off and in fact interrupt the fellowship for a year. We have introduced supplementary funding to help women attend conferences, looking after the family while they are going to conferences, et cetera. I met one of our URFs the other day who has taken advantage of this flexibility, so I am pleased to say that it is working. Professor Rothwell may speak more about it. The second point is that in the *Rising Tide* it became apparent that the place where the drop-out occurred was largely at the end of the PhD, at that stage, so what we have done is to persuade OST to give us some money for the Dorothy Hodgkin Fellowships which are, if you like, junior URFs. We have supplemented them by our own funds, but we are appointing ten this year, that kind of order. We want to see how it works, whether in fact we will be fulfilling a need by making those appointments. I think the third point is that we have done just what you have suggested in looking at the URFs, for instance, in looking, if you like, at academic age rather than real age and in looking at the record in making appointments, so that within our own structure we have made quite considerable moves, I think.

1212. But there are impediments which you cannot deal with, such as the lack of provision of crèches and so on in universities. Has the Royal Society expressed a view on those?

(*Professor Horlock*) We have said that we will assist with child care, for instance, for our URFs where possible.

Baroness Platt of Writtle

1213. Also, my Lord Chairman, you talked about a one-year break which to some women will be very valuable, but it has always worried me the fact that once a woman takes time out in any scientific, technological or engineering field, her knowledge and expertise is immediately affected and I have always, therefore, favoured the possibility of part-time work, job-sharing, off-site working, flexi-time and all sorts of different arrangements which can suit employer and employee very well if carefully worked out and of course the Daphne Jackson Fellowships

[Baroness Platt of Writtle *contd.*]

work on that basis. Does the Royal Society do that sort of thing as well?

(*Professor Horlock*) I think that we would certainly be receptive to applications for that kind of provision. I do not think yet we have agreed to any part-time URF working, but I look to Professor Lachmann on this. Another point is that we have also provided funds for another Daphne Jackson Fellowship—I think we are now funding two over the next two or three years.

(*Professor Lachmann*) The Royal Society has allowed a variety of arrangements on requests from the URFs . I am sure Professor Rothwell can speak about this more. There is however a real problem here which is very difficult to deal with. Research in active areas of science is a highly competitive activity and it is just not possible to say that we will do the research over twice the time and do it part-time while your competitors in America have, say, three people working on it all the time. Research is quite difficult in this respect. The Royal Society makes a constant effort to avoid any form of covert discrimination against women scientists and will do anything it can to help. However, we cannot make this problem disappear because in much of research there are no great prizes for coming second.

1214. I do understand that.

(*Professor Lachmann*) Research, therefore, provides great pressure on women, and men for that matter, who have outside responsibilities, and that is why, in the medical area, women tend to return more frequently to clinical practice where a temporary period of part-time work does less harm. It needs women of great industry, great character and great ability, such as Professor Rothwell, to overcome these difficulties.

Baroness Platt of Writtle] There is also the possibility of job-sharing. This is where I think it is frightfully important and the question in the paper asks, "Is the under-representation of women in science more a result of cultural attitudes than of more physical and structural barriers? How can it be remedied?" My experience, and this is now some years ago, as Chairman of the Equal Opportunities Commission is that if you are in a male appointing situation, the men concerned will not have had these difficulties and their wives probably will not have worked anyway in an employment situation and these matters of what I would call or what the EOC would call indirect discrimination are very difficult to tease out and it is where you need very careful ideas of flexibility and where people like Professor Rothwell will be a help because she will understand what the difficulties are. I am not suggesting it is easy to find solutions, but if people are sympathetic and understanding, very often solutions can be found by scientists and engineers who, after all, are there to deal with intractable problems anyway.

Chairman

1215. Professor Rothwell, I think you want to say something.

(*Professor Rothwell*) Just two points. Firstly, as scientists, we are in some ways very lucky and in some ways very unlucky. I feel we are lucky because generally the science community does not discriminate very strongly. There may be some indirect discrimination, but it is a very fair community and I think unlike some other areas and professions. I would very strongly reiterate Professor Lachmann's comments, that it is a very competitive profession, so it is very difficult for women to leave and then come back, but, in saying that, we are considering again the top fliers, those people who are going to be at the very top level of their profession who are competing with the best groups in the United States, for example, and there is again a very large body of women in research who are maybe not in this top 2 per cent, but yet are extremely valuable and they are the ones who perhaps could still come back quite easily without any problem of catching up, and there are some new schemes now operated by the Royal Society and the Wellcome Trust, re-entry schemes and part-time schemes, and these are things which I think should be very strongly encouraged.

1216. Could I just ask you a question following your remarks? Does it seem to follow from that remark that it is almost inevitable, and very difficult to change, that for many women scientists they are bound to be for a considerable period at any rate in this group of in-between technicians and leading investigators supporting the whole enterprise, but not subject to the competitive purchase pressures?

(*Professor Rothwell*) I think it would be fair to say that there is a large proportion, and certainly not all are bound to be, but there are clearly women who do very well.

1217. But it is whether there is an excess of them, you see, if you look at them in the group, and we have the figures.

(*Professor Rothwell*) Yes, and there are going to be more women in that group and I think it is women who particularly suffer from the short-term contracts because once they end the contract, they have nothing to come back to and the situation tends to gradually drag on so they do not return, so the two together are problems that exacerbate one another.

1218. I wonder whether we have really overrun our time somewhat, but whether there are really matters which you think we should have touched on but which we have not touched on. I think we know your views about the Masters Research degree and you accept, as a body covering the whole of science, that there is a great diversity of views there and that you are looking forward to the outcomes of some of these experiments. Is that a fair summary of your view?

(*Professor Horlock*) It is probably a kind summary, I think, my Lord Chairman.

1219. Well, do put us right.

(*Professor Horlock*) I think we reacted against it.

1220. Broadly why?

(*Professor Horlock*) Because we felt there are so many parallel opportunities now with the four-year courses coming through for the Masters degree. We also felt that some of the suggestions for inclusion in the content of Masters Research programmes should well come within undergraduate courses anyway in fact. So we saw it somewhat as an add-on and so we do not have a great deal of enthusiasm, but, being

[Chairman *contd.*]

scientists and engineers, we await the results of the experiments with interest.

1221. May I just ask you then a very simple question? All the pressures seem to be towards thinking of either a slightly longer undergraduate course and then a three-year PhD or a three-year first degree and perhaps then a Mastership year or MSc and or an infill and then a three-year PhD, but the more one extends the length of courses, the fewer people come through and this raises the question as to whether in fact the scientific community have faced the fact that a very significant proportion of those who do a degree at the first degree level are really looking for education through science and not necessarily employing it for the rest of their lives. Has the Royal Society given any thoughts to the general changes that there might be in respect of undergraduate education because of this reality?

(*Professor Horlock*) I think we considered that when we were giving our response to the MRes degree and we, therefore, welcomed the diversity in that some courses were becoming four years and some remaining three years. So we thought the people you were describing who would not become professional scientists would be taking the three-year course.

1222. Or a two-year course, which was suggested by Professor Pippard 25 years ago.

(*Professor Horlock*) A long time ago, yes, indeed. I do not know whether I would go as far as that. I did not go that far and support Pippard at that time, but I think there is sufficient diversity in these courses now that one can accommodate those two groups of people. But it does seem to me that the professional engineer now really has to do the four-year course.

1223. But the difficulty which the student faces is that the courses get longer and the grants are increasingly inadequate and the grant plus loan is inadequate which means that you are exercising a powerful deterrent effect on people going into science at university at all. I mean science, engineering and technology of course.

(*Professor Horlock*) Yes.

(*Professor Lachmann*) This is also greatly influenced by what happens at school. The UK has been able to enter students into PhD programmes after a three-year undergraduate training because school children in the sixth form, on the whole, have done nothing except the science subjects they are going to read, so that they enter university with a substantial technical education. If we are now seeing a move towards a broader education in the sixth form, which in many ways may be very desirable, we must accept the fact that undergraduates entering university will not be technically as well qualified as they have been in the past, and I do not think one can square that with any shortening of the undergraduate course. Otherwise we really will have first degree graduates who are not comparable in educational standards with their predecessors.

1224. When we were in Edinburgh the Scots claim to have found the solution to that! May I ask you if there are any points which we have failed to elicit from you which you really would like to present to us and which you feel you cannot present in writing?

(*Professor Horlock*) I think you have covered all the points certainly in our paper and many others, my Lord Chairman.

Chairman] Thank you very much for coming.

Supplementary Memorandum by The Royal Society

Royal Society University Research Fellowships

Leavers' statistics

(a) *URFs left to date*

	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Total
UK Univ	22	18	8	15	8	12	12	3	3	2	1	—	104 (72%)
UK ResCoun	2	—	—	—	—	1	—	—	—	—	—	—	3 (2%)
Abroad $	3	—	3	2	1	2	3	—	—	1	—	—	15 (10%)
Industry	2	1	1	1	1	1	1	—	1	—	—	—	9 (6%)
Other *	1	1	1	—	1	1	3	3	1	—	1	1	14 (10%)
	30	20	13	18	11	17	19	6	5	3	2	1	145

$ all to posts in USA univs except 3 (2 × 85, 92) Canada, 2 (86, 89) Sweden, 2 (83, 88) Germany, 2 (85, 86) NZ.

* 14 = 2 (83, 84) left sci, 2 (85, 88) other RS appts, 2 (85, 89) hospital, 2 (09, 90) deceased, 5 (89, 90, 91, 93, 94) not taken up, 1 (90) science journalism.

(a) *URFs still in post but known to have jobs to go to*

	1983	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*Total*
1995 ×	—	—	2*	1	3	2	1	3	—	2	—	—	14 (44%)
1996 ×	—	—	—	3*	1	2	—	—	1	2	—	—	9 (28%)
1997 ×	—	—	—	—	—	—	3	1	1	1	—	—	6 (19%)
1998 ×	—	—	—	—	—	—	—	2	—	—	1	—	3 (9%)
	—	—	2	4	4	4	4	6	2	5	1	—	32
													(inc 5*)

× in these years all those remaining from 1985–87 and 1988 will also end their appointments (at present 3, 2, 2 and 8 respectively).

* jobs assured at end of 10-year tenure.

All the above are taking up UK univ posts.

TUESDAY 23 MAY 1995

Present:

Craig of Radley, L.	Howie of Troon, L.
Dainton, L. (Chairman)	Phillips of Ellesmere, L.
Dixon-Smith, L.	Renwick, L.

Memorandum from Professor Howard Newby

I present my evidence against a background of having been Chairman and Chief Executive of the Economic and Social Research Council from 1988 to 1994 and Chairman of the Manpower Subcommittee of the Advisory Board for the Research Councils from 1990–1993. More recently I have become the Vice-Chancellor of a major research-led University with a rapidly expanding research income and a commitment to manage its research base more actively through, amongst other things, the introduction of Graduate Schools.

The expansion of short term contracts for research workers in British higher education institutions can be attributed to two major factors.

1 On the demand side this phenomenon largely represents the response of universities to the financial stringencies of the 1980s and 1990s. The round of cuts in university funding which began in 1981 made most universities wary of engaging staff on a long term basis at a time when tenure was a feature of the then university sector. In order to retain flexibility research staff were therefore placed on short term contracts which could be—and were—periodically renewed, but which did not carry a long term commitment from the university. Moreover, the additional burdens being placed on tenured university staff probably saw a decline in "hands on" scientific activity by many Principal Investigators who, instead, became research managers, devoted primarily to raising funds, overviewing the research of their teams and managing budgets. Little thought was given at this stage to the career development needs of the staff they employed, despite the fact that the traditional stepping stone into a full time university lectureship had all but disappeared because no such posts were available.

2 On the supply side there were sufficiently high numbers of highly qualified and highly motivated young people who wished to retain a foothold on the academic career ladder. Throughout the 1980s, at any one point in time, it was widely believed that the funding problems facing universities were temporary in nature. Therefore there would be a reversion "back to normal", so that those who could retain an academic position, however insecure and temporary, would be well placed to take advantage of any new opportunities on offer.

Many such young people had been encouraged, deliberately or inadvertently, to aspire to a career in higher education through the lengthy period of training which culminated in their award of a PhD or a postdoctoral fellowship.

The result of these trends was the very rapid expansion of short term contract research workers in all the universities with significant research income. However, the phenomenon has not turned out to be temporary. Many thousands of young scientists proceeded from one short term contract to another, often in highly specialised fields for which no serious alternative employment opportunities were available, nor considered desirable. The result is that there are now large numbers of such researchers in their mid-to-late 30s or even early 40s who are virtually unemployable elsewhere. Yet they have no serious career prospects. Thus even when the subsequent round of university expansion took place in the late 1980s and early 1990s they found it difficult to obtain teaching appointments, committees preferring instead to appoint younger, more recently trained, people who were often cheaper to employ and were closer to the frontiers of their subject.

We have now arrived at the situation where many research workers find themselves in an impasse as far as their career aspirations are concerned. Meanwhile the structure of the science base has become dangerously skewed in manpower terms and positive steps are required to remedy the situation. Nevertheless solutions are available and I would propose the following:

1 There is now an acceptance in the major research-led universities of the need to manage in a pro-active manner their research base. No longer is it regarded as a residual activity undertaken in the time left over from teaching and administration. Many such universities have introduced changes in their internal structures which can render this more effective—for example, the introduction of Graduate Schools. This allows such universities to seed corn their own research base, by taking in high quality graduate students and offering the best of them progressions through doctoral and postdoctoral stages and even beyond this for the very best of them, into research posts with a much greater degree of security. Universities can only afford to do this selectively and competitively, but it nevertheless

offers considerable incentives to the best young scientists to consider pursuing a career in research in the universities.

2 This kind of structure could be reinforced by a code of conduct. A fairly minimal version has been under discussion for many years between the Research Councils and the CVCP. However, the better universities, who wish to attract the highest quality young scientists, may well introduce their own codes of conduct which extend far beyond this. The increasingly competitive nature of research funding will probably drive several universities along this road—witness the recent announcement by the University of Warwick over its research fellowship schemes. A number of other universities, including my own, have introduced similar schemes and, in this context, graduate schools become merely a vehicle for managing the career development of all researchers in a more effective manner. The fact that many universities can now identify separate income streams for research and teaching assists this.

3 The above innovations would not, by themselves, be sufficient, however. On the demands side two important issues need to be addressed—the transferability of skills and the aspirations of postgraduate students. Looking back we can see that one of the problems facing short term contract researchers trapped in their existing posts is that their skills are not transferable elsewhere. Indeed, as a generalisation, it is true that research skills of this kind are less transferable than teaching skills. More might therefore be done (through the Research Councils and the Funding Councils) to encourage the introduction of teaching assistantships which will both enhance the transferability of skills amongst young postgraduates and postdocs, while releasing the time of principal investigators to undertake more hands on research.

Similarly the nature of the postgraduate degree needs to be differentiated so that it signals different career paths and does not assume that all students undertaking postgraduate degrees be imbued with the aspiration to become a leading scientist. In this point of view lies the origin of the proposals for the MRes. This would not only allow a larger number of postgraduate students to obtain transferable research skills, but would not assume that all, or even the majority, of them would proceed to a PhD and thence to a scientific research career. Thus underlying the introduction of the MRes is an assumption that we need to improve the transferability of skills, by, for example, offering more generic research *training* while limiting the aspirations of all but the very best postgraduate students over the pursuit of a scientific career. The MRes would provide a graceful exit for those who will never be scientific leaders but who nevertheless have a great deal to contribute, albeit primarily outside the higher education sector.

The intention is that the MRes should therefore provide a wider range of highly trained skilled researchers who could take up career opportunities among a much wider variety of employers. There is also evidence that many employers would welcome this, while still wishing to see a smaller group of doctoral students become genuine research leaders. There is some evidence that these sentiments are particularly strong among those industrial employers who have not traditionally taken on doctoral students—ie virtually the entirety of British industry outside the chemical and pharmaceutical sector. Equally and oppositely there has been some suspicion of the MRes amongst those industrial employers, such as in chemicals or pharmaceuticals, who have felt themselves to be well served by existing arrangements.

My experience at the ESRC has demonstrated to be that there is little point in producing an MRes which amounts to a national core curriculum in research matters. Rather it is important that a series of broad objectives are specified to which individual university departments may respond flexibly. Market forces will then prevail with the best students seeking out those courses which most suit their needs, but which also respect the extraordinary diversity of postgraduate research training between different disciplines and universities. In any case the MRes will only be one amongst a portfolio of Masters' courses available to postgraduate students. It is often overlooked how the expansion of Masters courses in recent years has created an age participation rate in Masters courses which matches that on undergraduate courses of only a few years ago. Such a trend is likely to continue as changes in the undergraduate curriculum begin to bite—modularisation, credit transfer, etc. Thus as we witness the growth of what is essentially a privatised fourth year, we need to consider the appropriate volume and scope of the MRes, both for those students who will wish to seek employment outside the higher education sector and those who will wish to proceed on to a PhD. The existing, rather half-hearted, introduction of the MRes seems to have taken little account of this changing context nor to be addressing the serious structural problems which now exist in the supply of scientific manpower.

Examination of Witness

PROFESSOR HOWARD NEWBY, Vice-Chancellor, University of Southampton, called in and examined.

Chairman

1225. Professor Newby, I wondered whether it would be helpful if we went through your paper first because there are one or two things which would help in clarification which certainly I have picked up, and then perhaps if you would want to make a general statement as background, and then we could proceed with normal question and answer. Would that suit you?

(*Professor Newby*) Yes, that is fine, my Lord Chairman.

1226. Then if we could look at your paper on page 1, I was puzzled by paragraph 2, which says "On the demand side", but surely that is the supply side, is it not?

A. Here I was, of course, talking about the demand of the young people themselves. From the point of view of the labour market, yes, it is the supply. Actually, looking at the version of this which I now have in front of me, I think that there is clearly a straightforward typographical error there if both paragraphs start "On the demand side", so the second one should be "On the supply side". Thank you for pointing that out, my Lord Chairman.

1227. It is a typing error of some kind, yes.

1228. Then if one could go on, you use the term periodically of a research-led university, a term of art which I think that the Committee would like to understand if it has any meaning?

A. I think, my Lord Chairman, that it has increasing meaning in today's world. By research-led university I mean that our teaching takes place within an active research environment, an environment where our research is at the leading edge of international excellence.

1229. In every area?

A. We aspire to its being in every area, yes.

1230. But where do you draw the line between those that are research-led and those that are not?

A. I think that there are universities—well, may I first just take one step back in answering the question, my Lord Chairman. I think traditionally this has not been an issue because there has been an organic link between teaching and research in universities. But with the expansion of higher education and the number of universities an increasing constraint on resources the universities have slowly but surely begun to differentiate. There are those who see themselves as primarily teaching institutions with some areas of research to back up that teaching mission, and those who see themselves as research-led institutions in which their teaching takes place within that kind of environment. We would put Southampton in that latter category, but that is by no means true of all universities and I think that we are seeing slowly but surely a gradual break in that organic link between teaching and research, universities having to choose more and more whether they give priority to their research mission or to their teaching mission.

1231. With those that give priority at the moment to their teaching mission do you think that they will always be hankering to have some research and, if so, who makes the decisions?

A. There will always be a hankering for some research because I think that in the world in which we live research rightly or wrongly is accorded higher status in most if not all universities than teaching and so the term has often been described as mission drift. I think that even those universities which have historically had very little in the way of research hanker after increasing their research effort. That at the moment is simply a fact of life.

Lord Craig of Radley

1232. Would that have been a financial-driven imperative?

A. It is a status-driven imperative, but the way in which universities are financed at the present time means that for many if not most universities it is a financial imperative as well since the only major way in which one can acquire a large amount of new resources is by increasing one's research rankings or research income.

Chairman

1233. Unless you live in Scotland where there is a teaching excellence that attracts 5 per cent more student units?

A. Yes, that is true, but in England there are at present, given the cap on undergraduate student numbers, few ways in which you can increase your resource. You can do it, of course, by increasing your number of overseas students, but that is really a very fragile base on which to run any university, so for whatever reason most universities are driven down the road of increasing their research income whether through the selectivity exercise and funds from the funding councils or through attracting external research income.

Lord Dixon-Smith] My Lord Chairman, you only have to consider the league tables published to see the effect of this pressure. The university that I am associated with considers itself to be a teaching university. When those league tables are published because it does virtually no research and in fact does not expect to despite what has just been said, because it has got no research it is one of the factors that pull it down to the bottom of the league table and the inevitable result for any institution is to try to climb up if you can. It is another aspect of the same problem.

Chairman

1234. I fully understand the funding formulae of both systems which are slightly different. May I just ask you, Professor Newby, one or two others points as we go through as I have jotted this down. Would you like now to make any general statement?

A. I am grateful for the opportunity, my Lord Chairman, but I think that the answer is really no, we could move on to the questions since I think that my statement which I have submitted to your noble

[Chairman *contd.*]

Lordships really covers the main points that I wished to have made at that time.

1235. Then continuing on the theme that we were on, can you tell me roughly what number of the universities in England and Wales at any rate would be in this research-led category—20, 30?

A. It is not a formal designation, as I am sure you are very well aware.

1236. No, I know.

A. We will probably be talking about something in the order of 30 or so who would think of themselves in that designation.

1237. And those you think are where the contract research staff are mainly concentrated?

A. Not necessarily, because even in the mainly what I have described as teaching-led universities, including the new universities—those which have achieved university status in recent years - I think that where they have attempted to increase their external research income they have done it largely on the basis of external contracted research income and therefore they have employed large numbers of short term contracted research staff. I am sure numerically it is true that they will be concentrated in those 30 or so because that is where the research is concentrated. But I would not like this to be thought of as an issue that is confined only to those universities.

1238. Thank you very much. You also say that the introduction of a graduate school ameliorates the situation. I wonder whether you can tell us in what way it does so?

A. It can ameliorate the situation because I see graduate schools as a mechanism whereby universities can manage their research base more effectively. Different universities have different ways, and rightly so, in which they are beginning to organise their graduate schools, but it provides a way in which you can take students in following graduation, put them through a graduate scheme, Master's, PhD, take the best ones on to post-doctoral level and the best of those on to offer them some kind of structured pathway research career which does not involve their necessarily going into teaching.

1239. Why do you need a graduate school to do this? I thought that this was general good practice?

A. It is not good practice, but I would suggest to you that it is one which many universities have followed over a considerable period of time until quite recently.

1240. So what added dimension does the graduate school do? Do people apply to do research through the graduate school?

A. Yes, there are a number of ways in which I think that it can add value. First of all, from the point of view of the university, as I said earlier, it can enable the university better to manage its research. Research increasingly has to be actively managed by universities, it is not something which can be left to a residual category after teaching and administration has been dealt with. From the point of view of the students I think that it gives them a better identity. Being a graduate student is often intrinsically a rather lonely activity. They have a sense of identity as part of a graduate school, they mix with other graduate students, they form a graduate student community, and it enables their supervision to be better organised and managed. I think that the days when most students can be provided with the kind of graduate training and graduate supervision that they require by a single supervisor are fast disappearing. They need access to more than one individual to help them acquire the training and skills that they need. Again a graduate school is a way of ensuring that that happens.

1241. And the graduate school sets down rules for this, approved supervisors and so on? Is that what you mean by managing?

A. Yes, my Lord Chairman. This of course can be organised in a variety of ways. Some universities would organise this centrally; some organise it in a decentralised way and would have more than one graduate school. My university happens to be in that category because we have a very decentralised structure as a university.

1242. Based on faculties?

A. They originate in faculties but are not limited by that because there are at Southampton graduate schools which we are establishing which would span more than one faculty because our faculty structure does not necessarily match exactly on to the emergent areas of science which we think are important to grow in the future.

1243. So would you also have the situation that these graduate school—I do not know what the subdivisions are—units, shall we say, also manage the contract researchers, do they?

A. That is right. In our case that is what they would do.

1244. In what way? Somebody, a principal investigator, has to get a grant first of all and then appoint somebody. Does the graduate school become involved in the appointment?

A. No, my Lord Chairman, but the graduate school is involved in laying down what I would call a code of practice by which both the supervisor and the supervisee abide. I think that the graduate school is much more concerned then, as I said earlier, with providing opportunities for the best students to progress through a structured scheme beyond, let us say, their PhDs. In that respect from a university standpoint it is a way in which we can acquire, develop and hang on to the best young research talent which as a research-led university is very important to us. We cannot assume that we are going to be able to go outside the university in all cases all the time and acquire the best people from outside.

1245. And would they be involved in managing the contract research staff in the same way?

A. Yes, my Lord Chairman, in terms of defining the terms and conditions of research staff, yes.

1246. Which would tend to be broadly uniform over the university, would it?

A. That is correct, yes, my Lord Chairman.

1247. So I begin to see it then. But they would not be involved in questions of policy making as to the areas in which the university would develop? Presumably that would lie higher up?

[Chairman *contd.*]

A. Yes, in our own case, we have a committee of senate which is called the Research Strategy Committee, which I personally chair which decides upon those things and which, indeed, decides upon the criteria for establishing graduate schools and the eligibility of graduate schools as opposed to other kinds of mechanisms, research institutes or centres.

Lord Howie of Troon

1248. A few moments ago you mentioned a code of conduct or a code of practice. Can you tell me something about it, I wonder? What would be in the code and what would its aim be?

A. Initially we approach this from the point of view of establishing approved and clearly specified terms and conditions for contract research workers. Many of these things I am sure your noble Lordships will regard as quite standard employment practice, but nevertheless I think that it is important to have them set out. They would include, for example, rights over contact with the supervisor and supervising committee, they would include specifying clearly the rights of contract research workers to have their names on published pieces of work.

1249. You are talking essentially about a contract of employment?

A. Yes, that is what I meant by terms and conditions of employment.

1250. Yes, of course.

A. But it would go beyond that in our case at least because we would also wish in this code of conduct to indicate the university's responsibilities to providing these contract research workers with some degree of career training and, as I have indicated earlier, for the best of them some means whereby we can provide additional resources beyond the expiry of their existing contract to enable them—for example, bridging finance—to work on obtaining funds for a further piece of work or whatever it might be.

1251. Further up the paper you remark that there are some researchers who are virtually unemployable elsewhere, and you go to say that they have no serious career prospects. Is your code of conduct intended to ameliorate that difficulty in some way?

A. Yes, it is, my Lord Chairman, because we are really concerned here with transferable skills, are we not?

1252. Not if they are unemployable.

A. They are unemployable at the moment because they have skills which are not transferable. They are so highly specialised and I think have been encouraged to think of themselves in terms of university employment that they have not developed the kinds of skills that might lead them to be considering employment elsewhere. For example, broadly speaking I think I would say that teaching skills are more transferable for this category of people than research skills would be, so it may be that the kind of training that they need is more on the teaching side than on the research side to give them a broader scope of employment.

Chairman

1253. Or does it run wider than that? Are you really referring to skills of communication generally?

A. Indeed.

1254. And by what media—the language?

A. By all media I think in fact. If there is no serious prospect of their pursuing their scientific interests within a university research setting, then we need to give them a set of skills that lies alongside those to enable them to pursue careers elsewhere in industry and in other parts of the education sector.

Lord Howie of Troon

1255. How do you do that? Do you send them on courses or what?

A. Yes, send them on courses. A university the size of Southampton would have those courses available for our own staff at all times, whether it is courses in communications skills and teacher training or whatever it might be.

1256. You said that they were highly specialised or even over-specialised. Do you try to de-specialise them in some way?

A. I think in common with many other universities, since you ask me really a factual question—do we do this?—the answer at present is, no, because this is part of the story whereby we have arrived at the situation that we are in. Most universities have not seen it as part of their responsibilities to do this kind of thing. At Southampton and I know at many other universities, research-led universities, we are increasingly thinking of this as part of our responsibilities and putting in place mechanisms whereby we can do this.

Lord Craig of Radley

1257. You speak up for the MRes as a way of—and I quote you—"returning transferable research skills" though I did wonder whether you were perhaps slightly damning the MRes with faint praise by suggesting that it would provide a graceful exit for those who did not go on to the full doctorate. But what I cannot quite get a hold of yet is why the MRes would give transferable skills in research, presumably as a training arrangement, but the actual on the job activity of a research scientist will not give him in any way a transferable skill because you are suggesting elsewhere that he is unemployable and difficult to move because he lacks adaptability?

A. Let me say first of all, my Lord Chairman, that I am personally very much in favour of the MRes so I would not like my comments to be thought of as damning it with faint praise, although there is a difficulty, so far unresolved, which I will come back to in a moment to which you have, I think, actually alluded. What I would see an MRes as doing is providing a broader range of skills for the research student than those which are needed to undertake his or her academic thesis. Now that is rather unusual because at the moment it is rare for students to acquire research skills which are not going to be employed on the pursuit of their thesis. Indeed, the

[Lord Craig of Radley *contd.*]

PhD is very much focused on the eventual production of a thesis.

Chairman

1258. Could you give us an example of the skills that you are trying to inculcate?

A. I think that there is a set of what I would call generic research skills—I know that this is a controversial view, but I would still hold to it—in terms of, for example, the ability to formulate a research plan, the ability to write up research results in a readily intelligible way and disseminate them to a wider audience than a narrowly academic one, communication skills we referred to, things of that kind, the ability to use a library, which you may be surprised is something that graduate students do have to be inculcated with.

1259. But it is the normal thing for universities to indoctrinate all new students to the postgraduate level surely on the use of their library resources—at least, in the universities that I have served in it was?

A. Yes, but that traditionally, I think, involved an optional tour round the library on the first afternoon of the week that they arrive.

1260. Oh, no, I speak as Chairman of the British Library of Political and Economic Science Library Panel which does it very seriously and has done for years.

A. That, of course, is a national library, my Lord Chairman, as you will know, and I think that the London School of Economics having that resource sitting on its doorstep is perhaps taking its responsibilities rather more seriously.

1261. Well, you force me into a corner. I must say that the same was true in Leeds and in Nottingham. I will not mention Oxford because that is a law unto itself.

A. I think I could provide you with counter-evidence that these days there are large numbers of graduate students who felt that they were inadequately trained in the range of bibliographic and technological resources available in a modern library.

1262. Really. May I just at this point ask this? You speak about the student as if he were alone, but in science, engineering and technology with which we are concerned, of course, the family home of the research student or the research fellow is a large, lively department where he is not alone and there are a lot of people interested in his progress. Is it your experience that in those areas there is less need for what you suggest than in the other areas or are they equally bad?

A. I would suggest that at the moment or traditionally at least we have had a rather hit and miss position, that is to say, that of course there are many supervisors and research teams which have given an excellent research training to their students; there are equally some teams and some departments and some universities where that has not been the case so that the idea of a code of conduct and an MRes is really to level up the provision of the training that we have. It varies very much from subject to subject as I think the consultation exercise in the run up to the White Paper proposals on the MRes demonstrated.

1263. Are you in Southampton getting one of the pilot schemes you can influence?

A. Yes, we are, my Lord Chairman, we are getting the one in chemistry.

1264. So this will be in a sense your own experimental laboratory?

A. I think that chemistry is a very interesting case in point. I refer to this briefly in my paper. I think that historically the training that has been given to chemistry students in this country has been excellent and there is less of a problem in chemistry in terms of transferable skills into industry where the chemical and pharmaceutical companies traditionally have recruited larger numbers of chemistry PhDs than there are in other subjects and sectors where we see that the recruitment is negligible and the students on the whole do not through the PhD require the kind of skills which industrial employers have been looking for, so the only option open in most other subjects has been an academic career or to do a PhD without a view to its enhancing one's career status at all.

1265. Being a chemist myself I do not want to attract too much virtue and it must be for me to point out that what you do in the chemical research laboratory in the university and what you first do in industry where they put you in the research laboratory and, as the first step is very similar, so it is perhaps easier in chemistry intrinsically than in any other subject and not the product of conscious thought on the part of the chemist?

A. I think also, my Lord Chairman, it is true that in chemistry the PhD is traditionally followed by an intensive period of postdoctoral training for those who want to arrive at the frontiers of the subject, and that is not necessarily true for all other subjects where the PhD itself is seen as bringing students to that point.

1266. This brings us back to the postdoctoral fellows, if we could just ask a particular question here. In the structure that you envisage how would the postdoctoral fellows be appraised from time to time, their shortcomings identified and remedied under the scheme of graduate schools that you have in mind?

A. I can only speak again, my Lord Chairman, for proposals in Southampton. They will be appraised at periodic intervals in the same way that all staff are through our own internal appraisal system, and that is really a way of feeding back to them a sense of how their career is progressing and identifying any training needs that they may benefit from. Beyond that, however, I think we would see that each step along this pathway would be competitive, so we are not saying that all graduate students would become postdoctoral fellows or postdoctoral fellows would become senior research fellows. At each stage there would be a competitive process to which they would be able to apply.

1267. And you would be saying quite frankly to some, "You have no hope of a post within this university" at any particular age when that was discovered?

[Chairman *contd.*]

A. Yes, my Lord Chairman, and that is what I referred to earlier as "graceful exit", and I have not really come back to that point. Perhaps I may do so, my Lord Chairman?

1268. Yes, please, Professor Newby?

A. I think that the one difficulty which remains unresolved with the MRes is how to prevent its being regarded as a failed PhD. It is not an unknown difficulty in universities because in some universities the MPhil is regarded similarly, and I personally think in a rather unfortunate way. That I think is the major unresolved issue. Otherwise I think that an MRes can provide a student with a further degree of research training which will enhance their employment prospects in a wider world than academia.

Lord Howie of Troon

1269. On this exit—graceful or not—matter, you talk on page 3 of your submission about the skills not being transferable. This is obviously true. Then you go on to talk about transferring these people to teaching skills and presumably into teaching. When they are in teaching a difficulty arises, I think—you will tell me if I am wrong. Would they still be on short term contract or would you be intending to put these people on the full time academic staff?

A. No, I am simply saying that teaching skills are more transferable than specialist research skills so that if we want to increase these people's employability, whether inside the university or outside the university, it may be that one of the things that we would have to look at is giving them some teaching training rather than further research training with a view, I should say, not to taking on a university teaching post, but with a view to teaching if that is what they wish to do elsewhere. There is a national shortage of very good science and mathematics teachers, as you know, for example, at all levels.

1270. Essentially what you are saying is that once you have given them the teaching skills which might be usable elsewhere, you wash your hands of them and hope they get a job?

A. We start from the premise, do we not, that there is no likely opportunity for them to continue their career within the university? Clearly if that is not the case, then we do not have a problem: Given that that is the case, we have to do what we can to give these people the kinds of skills which will enable them to enhance their employment opportunities elsewhere. Now I have mentioned teaching, but there may be other skills; it may be that that is not what is required.

1271. Let us stick to the teaching one which is the one that I have brought up. You talk of teaching assistantships which enhance transferability and release the time of principal investigators to undertake more research. That seems to suggest to me that these former researchers, now teachers, are employed within the university and the result is that to permit your better researchers to reduce their teaching load and do more research, am I right?

A. Yes.

1272. Well, that does bring back my question of whether these teachers are on the full time academic staff or whether these teachers are still short contract employees. What is your strategy there?

A. They would still be short term contract employees. The point that I am making is that the end of that period they are more likely to have employment prospects outside the university than they would be if they were on short term research assistant contracts. That is the judgment that I would make. Now we have arrived at a situation in this country as I know from my past as head of a research council in which the names that are submitted as principal investigators on an application to a research council are not necessarily the people who will actually be doing in a hands on way the research. From a research council's standpoint we have little way therefore of assessing the suitability of the people who will actually be doing the research because in many cases they have not even been employed yet and we do not know who they are. The more we can get back to a situation in which principal investigators are indeed the people who are doing the research, the better I think it would be.

1273. Have you actually done this in Southampton? Have you actually transferred some people from research to teaching, thereby allowing higher researchers to get on with their important work?

A. No, because I have been vice-chancellor for only nine months so these are proposals which we are now bringing forward.

1274. And you have high hopes of them?

A. Yes.

Lord Howie of Troon] Well, that is fair enough, I suppose!

Chairman

1275. Universities have a very high impedance factor, do they not?

A. You will be aware more than I will, my Lord Chairman, that universities are still just collegial institutions and these things have to be taken through college.

1276. Yes. I wonder whether I could just get this clear in my own mind on the same subject that Lord Howie has raised. As I understand it, you would like to see some of these people who are research assistants at postdoctoral level or junior research fellows or whatever have some teaching experience for two reasons. One is that it would add to their qualifications; the other is that it would be a resource for the university?

A. Yes, my Lord Chairman.

1277. That, of course, sounds to me very like the Instructor of the American universities.

A. Indeed.

1278. Which in my experience in places like MIT and Cornell are a total disaster in that they neglect the students to a very high degree because they see that their future does not lie in that and their looking after laboratories leaves a tremendous amount to be desired?

[Chairman *contd.*]

A. I can only say that that was not my experience at Wisconsin.

1279. You were in the dairy state, I was in New England and New York.

A. I think you are right to point out these factors, my Lord Chairman, which again are issues that need to be safeguarded against through the proper management of the university.

1280. They need to be watched.

A. Indeed. As you do not need to be reminded, my Lord Chairman, the position with regard to undergraduate teaching in the United States, for example, is rather different from that in this country and there is much closer contact between the staff and students in this country than in the United States. But you are quite right. We cannot just introduce it as though "You become a teaching assistant" and that is the end of the matter. It has to be properly managed and again a graduate school is a way of ensuring that it should be.

1281. May I just take one point which is really crucial to the whole thing. You mentioned yourself bridging funds. Where are those bridging funds drawn from in the resources of the university?Are you able to draw them from your contract income, from your general funding council income? Do you have a sufficient flexibility to be able to do that?

A. Yes, they are top sliced from our general research funding, whether it is from funding council income or from external income. At Southampton we are rather fortunate in that we have a very high external research income, the sixth highest in the country, so that we are able to top slice our profit on that and some of our funding council income to provide the resources both to fund the scheme that I have described and in other ways to assist in the process by, for example, offering our own internal university research studentships.

1282. So you have already planned this ahead, as it were?

A. Yes, my Lord Chairman. As I repeat, the idea is to provide a series of, a pathway really, from graduate students through to senior research fellows in a way that provides genuine career prospects for the most talented researchers.

1283. Now I wonder whether I may just push the subject back a little further to the undergraduate level because one of the striking characteristics now with the large numbers who are coming forward in science, engineering and technology is that an increasing and very significant fraction of them will graduate and never use the advanced technical knowledge with which they are traditionally endowed as a result of their first degree. This raises the question as to whether the first degree might not be rethought to take account of possible pausing points at which the student asks himself, "Will I want to be educated *through* science, *through* engineering, rather than become an expert *in* either of those two fields because it is a general asset to me in life?". Do you see any possibility for changing the undergraduate courses? Would you wish to see that to enable people to make their decisions a little earlier? I ask this question simply because deferring it to the MRes seems to me to be leaving it rather late.

A. I think that the answer to that question is very dependent on what emerges from the current review of 16 to 19 education and I would actually put it further back still in the sense, are we going to arrive at a system in this country whereby the vast majority of students do not choose between science and arts subjects at 'A' level but can retain at least a foothold in both and carry that through into university entrance. If that is the case, then it will certainly be also true that a result of that is a problem for what I would call the more linear additive subjects like science, mathematics and engineering where you cannot move on to one step before you have done the previous one. That will provide an issue for university curricula. I will now go out on a limb if I may and suggest that we will have to look again, I suspect, at the nature of the honours degree as opposed to what in Scotland is often called the general degree and to see whether the issues that you are referring to might be dealt with in that kind of way. But I think that this is dependent on what happens at 'A' level.

1284. Yes, a broad span of studies would obviously change the matter, but then one has to be careful not to increase the length of time for which a person is in full time higher education before emerging the other end because there might be a cost penalty increasingly to the student himself.

A. That is true, but of course it is already happening.

1285. Yes, but the fact that it is happening does not make it desirable, does it?

A. We are at the stage, are we not, where we almost have now a privatised fourth year?

1286. That is what you say in the document.

A. I think that I am right in saying that the age participation rate in Master's courses now is about what it was at the undergraduate level about six or seven years ago. That I would submit is a very significant change.

1287. If you were cynical would you say that that represents either on the one hand unemployment prospects for students with a first degree or a reluctance to face life on their part?

A. No, I think that it is the former. I think that since it is a privatised fourth year for the most part, that is to say, that it has to be self-financed or funded from non-government sources, it is very much a response by students to what they see as a means of enhancing their employment prospects, and there is some evidence for that, that their employment prospects are enhanced by the acquiring of a Master's degree. I think that they have recognised that and that is why more and more of them wish to go into a Master's degree, especially those Master's degrees which are tailored towards a vocational training.

1288. Yes, not just the MRes.

A. Indeed.

Lord Phillips of Ellesmere

1289. First of all, my Lord Chairman, may I apologise to the Committee for arriving late and to you, Professor Newby. I am sorry not to have heard all his evidence. I wonder though whether the exchanges that I have just listened to reflect the problem that the higher education system has been vastly expanded in the last few years to what is in effect the beginnings of a mass higher education system while still struggling to build upon the old elite higher education system and retain the properties of that?

A. I very much agree with that statement. I think that a lot of the things that we have been discussing and many other matters too are a result of the change from what is conventionally called an elite to a mass higher education system, expanding access for young people in higher education whilst simultaneously wishing to retain the universities as the major centres of research on an increasingly international competitive basis. We simply cannot have 104 universities of that kind. That is why the system is differentiation. It comes back to my first point before Lord Phillips arrived about the distinction between research-led universities and teaching-led universities.

Chairman

1290. This does tend to argue also, does it not, for increased mobility of students between institutions at the undergraduate level and so back to modularisation and credit transfer?

A. That is also true, my Lord Chairman, and it may be that if there is to be this increasing differentiation in universities we will see the research-led universities through their graduate schools essentially concentrating more and more of the research training effort as occurs in the United States where you see this pattern of wide provision of undergraduate teaching and university education coupled to a much more concentrated system of graduate education linked to the major research universities.

1291. I notice in this country, as has taken place in the University of Illinois, for example, which is huge, as you know, that some of the research-led universities in your terminology are reaching out locally to embrace higher educational institutions that have only recently become designated as such and associated colleges and so on are participating in their first degrees. Do these trends run counter to one another or are they complementary and do they enhance both?

A. I think that this is a major issue facing most universities over the next few years, certainly my own, that is to say, all universities will be committed to the principle of expanding access to higher education. But for a research-led university like mine we would wish to see that happen without diverting our energy and resources from our research-led mission. The resources are simply not there to do both simultaneously in equal measure. By resources I do not just mean money; I mean people's time. So at least in Southampton, and this is happening in many other universities as well, we are seeking to enter into partnership agreements with other higher education institutions in the region through which they can provide the widening access whilst we retain our research-led role and then provide a link from them to us for those students who would benefit from further periods of research training or graduate study.

Lord Howie of Troon

1292. My Lord Chairman, I should like to get away from reforming the entire higher education system at universities, at least, the schools down to the age of 15, and get back to academic careers for graduate scientists. On the second page of your submission you talk as you have elsewhere about the lack of serious career prospects for many of these people in their late thirties or even forties. A bit further down the page you say that the structure of the science base has become dangerously skewed in manpower terms. Do you think that the science base has become skewed because of the growth and the expansion of short term contract scientists?

A. I would put it this way, my Lord Chairman, that that growth is a symptom of the skewing that I am referring to. I think that it is just a way of describing the skewing; it is not cause and effect here. It is skewed in two ways. One is the growth of short term contract researchers and the other is actually demographics. The university academic profession is an ageing profession, so it is skewed in that sense as well. If you put those two things together, in the first decade of the next century I think that we are going to have a major problem in British universities in renewing our intellectual capital, our people, in the science base.

Lord Dixon-Smith

1293. I should just like to ask a question which has already been answered in a sense, my Lord Chairman. Are we in fact looking at a problem with the normal degree that the undergraduate takes in that its emphasis tends to be, if you like, towards training people ultimately to become researchers instead of ultimately to do engineering and science out in industry and commerce at large? Is there a sort of self-feeding aspect of this that is helping to create the problem at the undergraduate level?

A. I think that that statement was truer when we had the so-called elite system. The least line of resistance would mean that you would end up if you were sufficiently talented doing a PhD. I think that that is less true now that we have a wider range of institutions in the higher education system in this country with a very diverse set of missions.

1294. Then can I ask what you call research-led universities to focus it a little bit more?

A. If I am honest, my Lord Chairman, I would say that there are still tendencies in that direction, but they are much less strong than they used to be. I think that even the research-led universities now, if I can put it that way, are very mindful of—I think all research bodies—the need to serve through their students and through their graduate students a much wider range of employers than simply the academic employer. We do not see ourselves as simply in the business of renewing the next generation of teachers in universities. I think that that has been quite a

[Lord Dixon-Smith *contd.*]

major shift over the last ten or 15 years. Contrary to what is sometimes alleged, the links between those universities and industry, for example, are much stronger now and more permeable now than they were ten or 15 years ago and I think that all universities are very cognizant of that fact. Therefore, we do not see ourselves narrowly simply producing the next generation of academic staff by any means, no.

Lord Phillips of Ellesmere

1295. Nevertheless, my Lord Chairman, it must be very difficult for academic staff confronted with aspiring PhD students to avoid giving them the impression that if they really succeed they will end up as university staff.

A. There is a certain self-fulfilling nature in that in that in so far as most university staff are following a vocation and in so far as they are inspiring teachers, one would expect them to inspire first and foremost in their students a sense of the vocation of being an academic in a university, yes.

Chairman

1296. Professor Newby, we are running out of time. I just wanted to ask you one final question. It is simply this. Within the old universities to which we have confined ourselves, over the last 15 years roughly the number of established university staff has remained constant, as you have seen, but the contract research staff has multiplied four times from about 5,000 odd to 22,000. It does seem to me, and I think that you would agree with this, but I would like your comment, that it is absolutely essential that we must manage this 40 per cent of university staff at least in a way which is regarded as equitable across the whole 50,000 or so?

A. I absolutely agree with that, my Lord Chairman. As is clear from my submission, I think, these difficulties have arisen in part because universities have not managed these people in that way in the past. There was for too long in my view a sense in universities that this was merely a temporary phenomenon that would disappear, as I said in my paper, once things got back to normal. I think that it has taken too long actually for universities to accept their responsibilities towards these staff and to develop a form of career development and management that is appropriate to them.

1297. May I just ask you one little pendant to that? You did refer to the vast increase in money from resources outside. That cannot be the research council sector because that has not gone up; industry, of course, has gone up, and one gets the impression that industry is increasingly wanting to out-source some of its research in science, engineering and technology and the universities represent a good bargain for this. That may impose strain on the universities to the extent that you do not recover the full cost?

A. Yes.

1298. That way lies bankruptcy. What are the universities doing about that?

A. Indeed, it does, my Lord Chairman. In this country I think that the universities' collective record in recovering costs is not a very good one and so it is something which all universities I think are having to address very actively because, as you rightly suggest, my Lord Chairman, we could be extremely successful in attracting external research income and drive ourselves into bankruptcy thereby. That particularly applies if you look at the cost of renewing capital investment in universities which is often not included in the equations that are used. At Southampton we feel that we must set aside something in the order of £5 million plus per annum on a turnover of £125 million for future capital development. We are currently looking at the replacement of one part of our chemistry department, synthetic chemistry. We are looking at a building of £16 million just for them alone. That gives some indication first of all of what are the resources required to stay at the leading edge internationally; and secondly, what is the scale of resources which need to be built into our overhead recovery. It is a very important issue.

1299. I do want to go on in many ways, Professor Newby, but we must stop. Just one final question: it seems to me here that there is an obvious role for the Committee of Vice-Chancellors and Principals or that part of them which is concerned with what you defined at the outset as the research-led universities because they are going to have special problems compared with the rest, are they not?

A. Indeed, my Lord Chairman. I think in the last year or two the Committee of Vice-Chancellors and Principals has been digesting the acquisition of the new universities into its midst. It has now set up a review of long term strategy and within that there is a research subcommittee chaired by Dr Kenneth Edwards himself of which I am a member, and that is looking into some of these issues. I think, and I am sure that you would agree with me, that that is probably overdue. In the meantime there are, as I am sure you are aware, informal groupings of universities which do meet together from time to time to discuss these matters and certainly there is an informal grouping of leading research universities which does exchange views on these things.

1300. Is that the Russell Group?

A. Yes, it is the Russell Group.

1301. Finally, may I just ask you this. We have gone over a lot of ground. Are there any points that we have failed to elicit from you which you would like now to make in conclusion?

A. Just one if I may, my Lord Chairman, because I think that we became a little sidetracked on the MRes issue. I do hope that the pilot schemes on the MRes can be seen to be a platform on which the idea embodied in the MRes will grow. I do believe strongly that there is room for and a role for the MRes notwithstanding the comment that I made earlier about ensuring that it is not seen to be a failed PhD. I understand the concerns of the chemistry and pharmaceuticals industries, for example, that the existing arrangements were working quite well as far as they were concerned, so "If it aint broke don't fix it" was their real message. But there were many other sectors of industry, other academic disciplines, where

[Chairman *contd.*]

I think that does not apply and has not applied. I would not like us to see in this country an MRes which is laid down as a kind of national core curriculum for research training. That would be far too rigid and inflexible. But I do think that there is a scope for a degree where students can acquire a broad research training where universities are encouraged to deliver a set of aims and objectives against a broad MRes rubric; that is to say, universities are encouraged to deliver a number of needed research skills but without going into the detail and suggesting in great detail how universities should do that—I think that that would be too inflexible and too rigid. But I do think, my Lord Chairman, controversial though it may be, we have over-produced PhD students in this country and I think that the evidence is there, and we do need to ensure that this country continues to produce highly skilled research and technologically literate young people without necessarily believing that they have to undertake a PhD to achieve that.

1302. Thank you very much, Professor Newby.
A. Thank you, my Lord Chairman.

Memorandum by the University of Warwick

The University welcomes the Sub-Committee's enquiry into academic careers for graduate scientists. As the 1993 White Paper "Realising our Potential" (Cmnd 2250) recognised, the current pattern of contract staff in universities needs consideration. Warwick has improved its own internal mechanisms for handling such staff—for example, through creation of a central fund to provide bridging finance between contracts—and is involved in the national discussion with the CVCP, the Research Councils and other bodies.

The White Paper proposed an expansion of fellowships, and staff from the University have detailed knowledge of national schemes such as those supported by the Royal Society and BBSRC. The University has introduced a scheme of fellowships—the Warwick Research Fellowships—designed to provide longer-term support for the most able research workers (in all disciplines, not just science) coupled with the probability of subsequent permanent appointments. The aim is to make a contribution to improving careers as well as ensuring the quality of the University's research programme. The features of the scheme are:

- Each Fellowship will be tenable for six years with the expectation that at the end of the period, and subject to establishing significant research achievements, a permanent appointment will be offered at the level of Lecturer, Senior Lecturer, Reader or Professor. The scheme has many "tenure-track" features.
- Up to 50 Fellowships will be awarded initially. This compares with approximately 700 permanent academic staff currently in post. Those appointed will usually be in their late 20s or early 30s and have already established a significant research record, although flexibility is being maintained between subjects to allow for different career patterns.
- The scheme will improve the Univerity's age profile, with 23 per cent permanent academic staff and Fellows below the age of 35 years. This should position the University well for the next decade.
- The cost of the scheme will be about £1.5m pa, or approaching £10m over the six year period. The University has received no additional funding, and the scheme will be financed primarily from Warwick's own earned income.
- The primary emphasis of the scheme will be on research and each Fellow will be expected to establish an international research reputation. Fellows will undertake a limited amount of teaching (one-third load) to equip themselves for a longer-term academic career.

The Fellowships were advertised on an international basis, and there were no nationality restrictions. It has created enormous interest. There were some 6,000 requests for details, and 2,000 applications. These have now been short-listed, and applicants will be interviewed in the next month. About one half of the Fellowships will be located in science and engineering and a quarter each in social sciences and the humanities. The results will be announced in late February/early March 1995.

The University hopes that details of this scheme, and of the response it has evoked, will be helpful to the Sub-Committee in its enquiry.

Examination of Witnesses

SIR BRIAN FOLLETT, Vice-Chancellor, and DR M CARPENTER, Senior Assistant Registrar (Research), University of Warwick, called in and examined.

Chairman

1303. Sir Brian, you have had the advantage, of course, of having heard what has passed between Professor Newby and us. I wonder therefore whether you would like to make some general remarks since you know the background of our interest now fully from what has already been said?

(*Sir Brian Follett*) My Lord Chairman, I think that it is very clear that the University of Warwick is in many ways very similar to Southampton. It may be valuable to your Lordships to know that our turnover is essentially identical to that in Southampton, about £125 million. The numbers of students are broadly the same between the two institutions, about 14,000 each. The balance is different in the sense that we have 5,000 graduate students and about 9,000 undergraduates and so we have probably gone rather further than Southampton in terms of developing a graduate school—we have one in place. It may be interesting to talk a little bit about that. We have also introduced a fairly extensive teaching assistants scheme which is taken from the United States. But otherwise I think it struck Dr Carpenter and myself that essentially the matters that you were covering were the same although it seemed to me, if I dare say so, that you were covering everything from people who had left with a Bachelor's Degree through to those who had undertaken research for some years and were looking for a long term career. I suppose that you have asked us here this morning to talk about a particular version of the career structure we have put in place. I do not know whether your Lordships may find it useful though if, to bring you up to speed, as it were, before making the political observations with a small p relating to the research fellowship schemes, Dr Carpenter could give some numbers so that you have some feeling for the scale of the operation.

1304. Certainly, thank you very much. Dr Carpenter?

(*Dr Carpenter*) My Lord Chairman, thank you. The Warwick Research Fellowships, as I think that you know from our written evidence, are for postdoctoral research workers who have already started to establish their career records and are three or four years beyond their doctorate. The fellowships each last six years with the expectation of a permanent appoint at the end.

1305. When you say expectation, who expects, the candidate or you?

(*Dr Carpenter*) Both, my Lord Chairman. It is definitely the expectation of the university and we have given that expectation to the candidate.

Lord Phillips of Ellesmere

1306. Nevertheless it is made clear to a candidate that a judgment will be made at some point?

(*Dr Carpenter*) It is subject to satisfactory performance, yes, that is certainly right, and there will be a rigorous assessment after five years.

Chairman

1307. Do they have to make formal application for continuance?

(*Dr Carpenter*) No, my Lord Chairman.

Lord Dixon-Smith

1308. In the academic field or research field?

(*Dr Carpenter*) They will join the academic staff of the university.

Chairman

1309. Well, we have been told of one candidate who was offered one refused on the grounds that he was told re-application was necessary. Were we misinformed, do you think?

(*Dr Carpenter*) I think perhaps that is not the impression that we have given to the candidates. It certainly is the expectation, it has been an integral part of the scheme, that subject to satisfactory progress, as I said, they would be offered a permanent appointment as a member of the academic staff.

1310. And the contract does say so, does it?

(*Dr Carpenter*) Yes, my Lord Chairman.

1311. That they would be offered an appointment?

(*Dr Carpenter*) Yes, my Lord Chairman. The further details of the scheme made this quite clear.

1312. I wonder whether it would be possible for us, as we have never seen any one of these schemes, to be given details some time?

(*Sir Brian Follett*) Yes, my Lord Chairman.

1313. Thank you very much.

(*Sir Brian Follett*) I think that the conditions of employment make it very clear. Each is offered for a fixed period of six years with progress and performance being reviewed annually by a standard appraisal system similar to that we use for all other academic staff. During the fifth year of the fellowship the appointment will be reviewed by the promotions committee on the basis of criteria, which are set out elsewhere. As a result of that review, the fellow will be informed either that the appointment has been so successful that a permanent appointment to an academic post is given or that the appointment will terminate. The expectation is that in the great majority of cases the decision will be to offer fellows continuation of appointment. Then there are some details which are the criteria that individuals have to meet. Those criteria, of course, are not dissimilar from those of most tenure structures in United States universities.

1314. Just to get it absolutely right, Sir Brian, you have been quoting from—?

(*Sir Brian Follett*) From the Conditions of Appointment of the University of Warwick research fellowship.

1315. I see, not the contract that an individual would receive?

[Chairman *contd.*]

(*Sir Brian Follett*) The individual contracts have the same conditions of appointment attached to them.

1316. Thank you, I wanted to get that into the record. Dr Carpenter?

(*Dr Carpenter*) Thank you, my Lord Chairman. The emphasis of the fellowships is on research, but each fellow will be expected to undertake one third of the usual teaching load of a member of staff in the department into which he or she will become a member.

1317. The usual teaching load being—?

(*Sir Brian Follett*) It varies from department to department. That is why we have called it one third of the usual teaching load. It will vary from economics to humanities to chemistry.

Lord Howie of Troon

1318. Does that mean one third of the amount of teaching that the permanent staff does?

(*Dr Carpenter*) It does, yes, my Lord Chairman. It does not mean one third of the time of the fellow. The fellowships were offered in all subjects that are represented in the science, social studies and arts faculties at Warwick although we did indicate some areas where we would particularly like to have strong applications. Now just to deal briefly with the response to the advertised scheme, my Lord Chairman, it elicited about 8,500 inquiries overall. We actually had 2,000 firm applications. These figures that I am giving, my Lord Chairman, are for the whole of the scheme. About 75 per cent of these figures are in the sciences and social sciences. We interviewed of the order of 150 short listed candidates and so far we have released funds to make about 35 appointments to begin in the autumn or shortly after.

1319. And the money is drawn in the same way as Southampton draws its money, from your general income of all kinds?

(*Dr Carpenter*) Yes, that is quite correct, my Lord Chairman. Over the six years of the fellowships we estimate that the awards made so far will cost something of the order of seven and a half, eight million pounds, and that includes not only the salaries but the start up costs that each of the fellows will be given as well. As you say, my Lord Chairman, the cost has been entirely funded by the university itself without specific outside support for the scheme. The university's core grant from the funding council now only accounts for something like 25-30 per cent of the annual turnover and the university's own earned income activities, as we refer to them at Warwick, which cover research grants, contracts, overseas fees, accommodation, conferences, that sort of activity, bring in something like £70 million in a year and it is the surplus from those activities that have helped us to develop this academic fellowship scheme.

1320. You say that you have made 35 appointments. Do you hope still to make it up to your 50?

(*Sir Brian Follett*) Perhaps I may take that question, my Lord Chairman. Yes, I think that the scheme has proved remarkably successful in the natural sciences and in the humanities where applications could range from 20 to one appointment being made to 70 to one in some of the scientific areas. We believe that we have made about the right number of appointments in those areas of the university. Interestingly, the scheme does not appear to have been quite as successful in the social sciences, and I think we have learnt from this scheme that the way in which people develop their careers in social sciences is in a slightly different pattern, so we have under-appointed, as it were, in the social sciences. We are hoping to be able to release the remainder and, indeed, may add to that number in the next two years. I might add, my Lord Chairman, that this kind of fellowship scheme was in fact first developed by Lord Phillips, who in 1983 at the time of concern over cuts in universities, established the Royal Society university research fellowship scheme using money from the then ABRC. I inherited that scheme in 1987 when I became Biological Secretary of the Royal Society and developed it with his support, I may say, when he was chairman of the ABRC, to the point where it now has 250 fellows scattered in the natural sciences across the country. Therefore, when I moved to Warwick I was very interested in developing his model in a university context because it had not apparently been tried. That is the model that we developed. In the end we went for a single six year period, but I wanted to do something that was not possible for the Royal Society scheme, and that was to give it a tenure track dimension so that the person appointed would have an opportunity of knowing that if they reached reasonable criteria, fairly high criteria, they would earn a permanent post, so the shape of the individual research fellowships that we offered within the university reflects this. Therefore, we have released three to biological sciences or five to mathematics, but we have taken cognizance of the vacancies that will appear in 2000 and immediately thereafter. We could have appointed many more outstanding fellows in biology or mathematics, but we really felt that that was going to cause difficulties with the second half of our scheme which we believed to be important, and in some senses it is very important for your Lordships' interests in stability of contract researchers.

Lord Craig of Radley

1321. That is very interesting, but are you suggesting that in the case of the individual who gets this fellowship, and is likely to go on to a tenure academic post in university, then that post when it becomes vacant will not be competed for in the open market but will be enclosed?

(*Sir Brian Follett*) Yes, you are quite right, that is perfectly true.

1322. So you are making a very long term guesstimate as to whether the individual that you are putting your money on will in fact be the best that you would want available six or seven years hence?

(*Sir Brian Follett*) We are, but we are not offering them permanent jobs as distinct from the existing arrangements in the universities where if you are offered a lectureship in universities in many instances

[Lord Craig of Radley *contd.*]

within 36 months a decision has to be taken as to whether that is made permanent or not. Our arrangement is much closer to the American model of a tenure system.

Lord Howie of Troon

1323. Am I to suppose that the profile of the appointments which you make related to the department in which they are made is determined by your employment strategy, looking ahead, rather than by the qualifications and capabilities of the applicants?

(*Sir Brian Follett*) There were strategic decisions taken. I think that one could go through the 29 departments in detail, although obviously I will not, my Lord Chairman, saying, why, for example, we decided that we would allow two fellowships to be appointed in classics - that was part of a rebuilding structure—five in mathematics, because mathematics at Warwick is a world class leading department and we wish to sustain it at the highest level, so there were strategic decisions which lay behind it and there were bids made by departments to us in the centre which we declined because we did not feel that the cases were strong enough; or, for instance, in one case the balance of the academic staff age structure in that department was already quite young and it seemed to us that in some senses we might overbalance it. I had hoped that we would rebalance the age structure slightly, and we have achieved that: we have injected 36 people under 35 years of age and have in fact now generated a fairly stable age structure for the next 20 years. We were rather interested in seeing whether we could trigger by this method the appointment of people of rather different characteristics. Inevitably if you lose an individual in algebra there is a tendency in the department to appoint another algebraist. We were interested in seeing whether such a research fellowship scheme would lead to a number of interdisciplinary appointments (an unfortunate word, but you know what I mean), new areas, and I am glad to say that that worked very well. I will, if I may, my Lord Chairman, end this by saying that we debated the name of the scheme because Warwick teaches and does research and they are of equal importance in a university like ours, and I wish we had one word that would reflect the even balance. In the end, because of the nature of it, we called them research fellowships rather than research lectureships because of the connotation there, but the one third teaching load is seen as a critical element. It is not something that is put on the side; it is a vital element because we are a teaching institution, and we think that these new people coming in with their one third teaching loads will add very substantially to what is on offer, apart from being young as well.

Chairman

1324. Whilst they hold these fellowships can they be principal investigators in applying for research funds from outside?

(*Dr Carpenter*) Yes, my Lord Chairman, they may. We specifically say that and made that an important feature in the terms and conditions.

1325. I think, of course, that that would be a particularly attractive thing to have for a very able person.

(*Sir Brian Follett*) The evidence from the Royal Society scheme which I presented to the ABRC about two years ago suggests that such fellowship schemes do attract better than average people and one could quantify that. It is difficult, but we were able to demonstrate I think to Lord Phillips when he was at the ABRC that the Royal Society fellowship people were more successful than the main bulk of university lecturers on technical research grants.

Lord Craig of Radley

1326. These fellowships are open equally to men or to women?

(*Sir Brian Follett*) Yes, they were open equally to men and to women. Of the 2,000 applications, 18 per cent of the applicants were women. You must recall that this is across all academic areas.

Chairman

1327. Were they distributed in the usual way?

(*Sir Brian Follett*) Yes, they were distributed in the usual way with only 7 of the 162 applications in engineering being from women. At the end of it 34 per cent of the appointments were of women so that during the course of the process from application to appointment it went from 18 per cent to 34 per cent women and you will be interested that just under half of the appointments in social sciences and humanities are women, a quarter of the appointments in the natural sciences and engineering.

1328. And the average age of the women, was it higher or lower or about the same?

(*Dr Carpenter*) It is slightly higher, my Lord Chairman. I think that the average age is 32 for women and 31 for men.

Lord Dixon-Smith

1329. My Lord Chairman, may I just pursue one further question before we drift away from it altogether. I was interested in Sir Brian's initial remarks when he appeared to be slightly critical of our questioning of Professor Newby because we ranged so far if you like from the subject of our investigation. If you will forgive me, he has now of course done that in answering us himself! What intrigued me, to go back to the question, was, you take a strategic view of how you are going to allocate these fellowships in relation to your existing academic structure, but this is a very long term commitment. I wonder whether your confidence in your future structure is so great that you are not tying yourself into what might perhaps prove to be too rigid when you get six years down the line, or is it so relatively small a proportion of the whole that it will not have an impact?

[Lord Dixon-Smith *contd.*]

(*Sir Brian Follett*) I think that one would have to say that the last is correct, my Lord Chairman. Fifty appointments out of about 700 permanent faculty positions means that we are talking of obviously about 7 per cent so I think that that would be true. You are quite right in observing that it does take long term strategic decisions. In some ways the situation at Warwick is easier than it would be if it was a weaker institution. That is not being arrogant; it is simply that what we do at Warwick is adjudicated as being in the top grade virtually entirely across the whole structure, so 85 per cent of the faculty are in the top two graded categories. You can see that in all league tables that emerge as to where Warwick's position is. So in a sense there is no managerial decision of the major sort that we would close down any of the existing areas, although we did look very hard at the one department that fell to a grade two; we got very close to closing that. In the end we decided not to close it but to rebuild it. It was classics.

Chairman

1330. May I come back to the numbers because I think you said at one point the number of normal academic staff, if I can use that term, was about 700, is that right?

(*Sir Brian Follett*) Yes.

1331. If therefore you had the average number of contract staff, that would be somewhere about 400 additional contract staff, is that the case?

(*Sir Brian Follett*) The figure is actually slightly lower than that because Warwick is quite strongly biased towards the arts and social sciences. I think the number is about 320.

1332. Three hundred and twenty, yes, and that means that, allowing for the new fellowships who are only a small proportion of the contract staff therefore. What happens to the others, say the total number minus the 36?

(*Dr Carpenter*) Yes, my Lord Chairman, we do recognise the question certainly, that the Committee has been addressing in terms of the career prospects for contract scientists. As the vice-chancellor has just been saying, at Warwick we have just over 300 contract scientists on short term appointments, about 60 of whom have been at Warwick for more than five years. Over the last ten years the number of contract staff has grown about 70 per cent or something of that order compared with a much lower growth, of course, in academic staff, so that the gap has widened in our university as, indeed, has been the case nationally. In one way we do welcome this increase in the sense that it is expressing the considerable rise in grant and contract funding that is coming into the universities, and this now stands at about £17 million per annum at Warwick. Short term staffing also, of course, does allow us a certain element of flexibility, and that has to be recognised. But I said at the beginning of these remarks that we certainly do understand the difficulties for the staff involved. Now your question was what have we actually done about these. We have taken some steps in the last few years to try more fully to recognise the position of these staff and the important position that they hold in the university. Just to give you one or two examples, my Lord Chairman, we have strengthened our management of these individuals. Contract staff now participate in our staff development and training schemes. We have recently introduced a formal appraisal scheme for these staff which can include a discussion about future career prospects for them either within the university or outside. As we were hearing earlier from Professor Newby, we have established a central bridging fund to continue short term appointments when on going funding is in prospect. One small point that was a point of contention in their terms and conditions of appointment previously was that we used to apply the waiver to redundancy payments coming to the end of a fixed term appointment. We now no longer use that waiver when they have actually been in our employment for more than five years. As one final point, my Lord Chairman, we have now arranged that staff can be offered appointments on a permanent basis when there is an expectation that the appointment and the need for the appointment will actually continue for an indefinite period. Perhaps those are relatively small steps forward—some of them larger than others—but I hope that they go some way towards meeting these concerns.

1333. May I now just ask you about salaries? Is there a kind of correlation, linking across from the contract staff to the academic staff in terms of rank, salary, superannuation? Of course, they cannot have the tenure, as you mentioned. Do you have a common grading scheme which matches both sides?

(*Sir Brian Follett*) Yes, my Lord Chairman, there is, of course, a national grading system, and they fall under the terms and salary conditions and pension scheme which is identical for all academic staff, academic-related staff and research staff.

1334. Yes, so that you do not have the problem that some universities have where we were told that the research staff do not in fact link directly to the academic staff?

(*Sir Brian Follett*) Certainly not, no.

Lord Howie of Troon

1335. I thought that I heard you say that some of the short term contract staff were taken on full time as appropriate. Are any of the short term contract staff eligible to apply for fellowships? I say this because there would be a distinction in regard to the position if they did get a fellowship whereas without a fellowship they might get a job if one turned up whereas with a fellowship there would be an expectation, and the two things are not quite the same?

(*Dr Carpenter*) Yes, my Lord Chairman, that is an important point, and the answer is, yes, they were eligible to apply for fellowships, and in fact two have taken up the fellowships, so they now have the expectation that we were referring to earlier.

Lord Phillips of Ellesmere

1336. My Lord Chairman, I have two questions. First of all, of the 320 contract research staff, are any of them, I think it is called grade RA-1B and registered for a PhD?

(*Sir Brian Follett*) Rather few, due to the fact that the line that we have taken at Warwick, and in some departments it is an absolute line, is to debar people from RA-1Bs from registering for full-time PhD degrees.

1337. I brought up the question, my Lord Chairman, because when I organised a study of this sort of problem in an earlier life I was surprised overall to find what a large proportion of contract staff are in fact registered for PhDs, but it does not apply in your university?

(*Sir Brian Follett*) We have tried as far as possible to keep it to a minimum.

1338. The other question that occurred to me is this. When you come to the assessment of these contract research staff, is that assessment done on a departmental or a central basis?

(*Sir Brian Follett*) I think that it is done primarily centrally. It would be if we were going to produce a rolling contract for an individual. Dr Carpenter, for example, led a team to look at two cases only last week where it has been decided as a direct result of his advice that we will provide them with a much longer rolling contract for the next three years. Each case is looked at individually, but not necessarily only within the department.

(*Dr Carpenter*) Some of the assessments and appraisals will actually be undertaken within the department because they relate to the particular circumstances and discipline of the person concerned, but there will be a watching brief from the university centrally.

(*Sir Brian Follett*) It seems to me that what we have got is the classic problem that everybody has. Most of the grants that we get are for one, two, three years. The people are offered contracts for that term and then they run out. If a person can build up a suitable track record so that they have managed to get two or three of these contracts, then I think universities are trying to grapple with the problem. University College London (UCL) has addressed it, and we are trying, and we are moving to a situation where more of the long term researchers are being offered a permanent type of contract. That contract will in the end depend on their being able to raise the funds, but what they will have out of it perhaps is a somewhat more secure situation where, for instance, if a contract falls in they would be supported for one year or two years. Whether the university will give such a reasonable long term guarantee to an individual I think very much will depend upon the nature of the individual and the nature of the subject that they are in. We are finding that in the social sciences there are a number of quite short term contracts available—six months, one year—and really that is a very unstable situation in which to ask people to be who are in the mid- and late-thirties carrying out research which I suspect is of enormous value to the community in many ways—race and ethnic relations and industrial employment practices. There I think that we are finding ourselves under in my view reasonable pressure from the social scientists to move them particularly towards these kind of rolling or semi-permanent contracts.

(*Dr Carpenter*) My Lord Chairman, may I add that it does of course also depend at least to some extent on the attitude and policies of some of the funding bodies who are providing funds for these short term appointments, for example, the research councils. If they could provide some help in this sort of area, perhaps a greater stability, a greater continuity of funding, this might actually help Warwick and other universities to come forward with schemes as well.

Chairman

1339. Are discussions taking place with a view to achieving that?

(*Dr Carpenter*) I believe that there are discussions between the research councils and the Committee of Vice-Chancellors and Principals and the Royal Society to see what can be proposed in this sort of area.

1340. We are told that they will probably not report for a couple of months, is that the case?

(*Dr Carpenter*) I think that that is so, yes, my Lord Chairman.

Lord Phillips of Ellesmere

1341. I am surprised, my Lord Chairman, at the implication that research councils are responsible for these very short term grants—six months and so on. I should have thought that was much more for local authorities and other agencies looking for particular studies on social science issues?

(*Dr Carpenter*) I beg your pardon, my Lord Chairman, I gave the wrong impression. I was not really referring to the six-month contracts. Lord Phillips is absolutely correct. I was referring to the typically three-year research assistant on research grants from the research councils.

1342. If I could just pursue this, my Lord Chairman, after all, at one time I ran a laboratory which depended a great deal on this sort of staff and if one made the judgment that a person was making good progress at a particular piece of research council supported research and that that research ought to be developed, then usually research supervisors applied for a renewal of the grant or the award of a related grant to carry the work forward say 18 months before the expiry of the grant. I am really rather surprised at this emphasis on the need for a bridging fund. That smells to me—and I would like your response to it—of bad management.

(*Dr Carpenter*) I suspect that both approaches are required, my Lord Chairman—foresight in those areas where it is possible to apply for a renewal of awards and certainly some research is on going in that sense and can be applied for 18 months or a year before the end of the existing research grant. I think that other areas of research perhaps may be rather more one off and discontinuous, and it may be that we would want to retain the skills of a particular research worker but on a different area of work funded by a different sponsor. In that sort of way I think that the bridging fund might be quite useful.

[Lord Phillips of Ellesmere *contd.*]

1343. Does this, my Lord Chairman, get us into the distinction that I think needs to be made between these contract staff who may be prospective research leaders and are likely therefore to be involved in work which has some sort of continuing possibility and staff who are much more senior research assistant types who are technically strong and act as support staff in the research groups? Is there a specific problem about the second category?

(*Sir Brian Follett*) I think that there is a specific problem developing of the second category. Certainly in some senses the research fellowship scheme both at Warwick and, indeed, at the Royal Society was designed to pick up those research leaders hopefully in their late twenties and then set them loose because of our belief, among many others, that youth is a very important factor in developing research strengths; and, of course, it is those sorts of individuals whom we at Warwick and other universities are looking at to try to offer permanent contracts in other areas such as the social sciences where this short term contract business or short term financial contracts are much more prevalent. I do not readily myself see a solution to the position of the many people who are in the second tier of research and not necessarily research leaders. I think that it is that group in many ways that lies at the heart of the problem of the 22,000 that we are talking about, that at the bottom is a large number of those 22,000 who are young people and will move on either out into industry, we hope, or develop themselves. At the top of that group I think that we have a problem in that the very best of those will be picked up by schemes like fellowship schemes or move directly into lectureships or into senior positions in industry, or junior but going on to senior positions. But the other group worry me a lot and I do not think that we have found a sufficient answer to them. They are very unstable.

Chairman

1344. This is, of course, not a new problem?

(*Sir Brian Follett*) No.

1345. It has always been, and it has just become greater in magnitude, I think. What used to happen before the war was that in some universities—I think of Cambridge—they had Assistants in Research. It was the kind of person who was there on the permanent staff, not quite technician, given the responsibility of looking after a technique with perhaps a piece of machinery or whatever. On the backs of people like that the innovative research was very often done because they provided a service, but they were not in their own sense in any way pretending to be independent researchers, nor ever would be. Indeed, some of them were occasionally only in associateship of the Royal Institute of Chemistry or something of that kind. But they are terribly important still to this day. They too will have to be managed, would you not agree, in the future unless the whole edifice is to crumble?

(*Sir Brian Follett*) My Lord Chairman, yes, I think so, but I think, running a university which is reasonably successful, that the core permanent staff of the university will centre on one's academic teaching and research staff with a relatively small number of technical staff to service the laboratories, and secretaries. Beyond that I think that we are already in the position that has been widespread in the United States for 20 years that all other staff are on short term contracts of one form or another. I am not saying that it is necessarily a good thing, but I think that it is with us as strongly now in Britain as it was when I last worked in Michigan in the early eighties. I think it is very common.

1346. May I just come back to one of the criticisms that were brought to our attention not once but many times that the short term contract on which many of the researchers are engaged—I am not now thinking of the assistant in research category, technician category that we were talking about but of the able young—that that uncertainty has a very damaging effect not only on the people themselves but on the quality of research which is now done given the fact that establishing for themselves a reputation tends to force them to do research which is publishable and therefore safe and predictable?

(*Sir Brian Follett*) Well, my Lord Chairman, I have heard—I think that we all have—those views. My feeling at the moment, and I have felt it for some time, is that we have a relatively short PhD in this country and certainly in the natural sciences and engineering it is probably a very good thing that that is then followed by one or two periods of postdoctoral research, and quite likely one of them will be in the States. I am inclined on the whole to suggest to research councils that they do not get very heavily involved in supporting individuals at that stage and that these young people are picked up on more senior academics' research grants on these relatively short term contracts. My concern really has always been when people reach an age of about 29 when it seems to me that after two such contracts they should be allowed to develop a more stable career if they are going to stay in research; and secondly, that they should as importantly be allowed to run free. It was really the Royal Society's scheme of offering five years which was so attractive at that point because suddenly you were moved out of the short termism and in the Royal Society scheme it is five plus a further three years. At Warwick we decided to offer a simple six years, but the principles are essentially the same, to unlock young people in their late twenties. I remain wedded to that. Other people might disagree or would wish to balance it in a different way. So that is the way that it is. I do not worry so much as perhaps others do about the short termism in research.

1347. You do not think that it has had an adverse effect on quality?

(*Sir Brian Follett*) I think that it would be extraordinarily difficult, my Lord Chairman, to prove that anything in the research assessment exercise had negative effects of that sort. What the research assessment exercise certainly has done, however, is to put it fairly and squarely in front of the eyes of the academic staff of the universities of this country that for the bulk of them they are expected to undertake research alongside their teaching and that we will need some kind of measure of their productivity. So I think that to me it has been one of

[Chairman *contd.*]

those concerns where, yes, it is possible to see a concatenation of circumstances whereby the research assessment exercise is negative. I on the whole incline to believe that it has done more good than harm, as I do, I may say, of a teaching exercise.

1348. Thank you very much. I think that we have covered a great deal of ground, Sir Brian, but perhaps we ought just to return to the questions which are in front of us. May I ask you whether you feel that you have any comments on any of those questions which I think were given to you before? We have not, for example, touched on MRes and we have not I think touched on the question of women in these fellowships other than the statistical fact of their relative proportions. Are there any questions or points that you would like to bring to our attention which relate to these questions?

(*Sir Brian Follett*) Only two, I think, my Lord Chairman. I think over issues related to women and training of fellows in non-technical areas, it seems to me that in research perhaps above many other endeavours in this life high morale is a critical part of whether one will be successful, and it therefore is in the best interests of the University of Warwick that it puts in place the most supportive mechanisms so that the staff are supported whether that be on the basis of gender or whether it is on the basis of other areas. I notice the question: what criticisms have you received, if any, and from whom, since the announcement of the scheme? On the whole I think that most of us have become self-critics. We do not believe that this scheme as outlined is perfect for social scientists. We think that it needs some rejigging to take that into account. The second thing is that there has been a criticism made that we are buying in research excellence, as it were, for a 1996 exercise. I think this is certainly a charge that can be made.

1349. That is your job, is it not?

(*Sir Brian Follett*) Oddly enough, my Lord Chairman, it is a hurtful charge in one sense, that of course if you were doing that you would not have brought in research fellows at the age of 30 but you would have brought in stars at the age of 45, so we elect, I think, to put our money on youngsters rather than on more senior people. Otherwise—

1350. If I may just interrupt there, Sir Brian, I do not think that I quite accept that point. It seems to me that you are getting young people in their creative period and you are getting a much better bargain. They will build things up for you rather than having the exploded bombs in their 45 and upwards years.

(*Sir Brian Follett*) That is what we hope although I think that we are looking at it more as an investment for the year 2000 than that we are looking at it in some ghastly short termism.

1351. Has your age profile of staff got a great bulge which will be working out of the system at the end of the year?

(*Sir Brian Follett*) No.

1352. Being a new university in the old terminology you have avoided that?

(*Sir Brian Follett*) The pattern of staffing at Warwick is identical to that in all the other old universities. I think that we are now at a point where they are all essentially the same. Two observations, my Lord Chairman: Warwick does not have a bulge, and secondly—

1353. In that case you are not the same?

(*Sir Brian Follett*) Well, we are, I hate to disagree with you, my Lord Chairman, but the funding council had a survey of staffing patterns which it presented to the funding council I think two meetings ago and—

1354. Are we talking about the same thing, the age distribution?

(*Sir Brian Follett*) Yes, the age distribution, in which in fact, as a result of that survey, it was felt that there was not a major national problem because a number of us had been concerned about this as to whether we should think of a new blood scheme, and we were quite interested, and I am sure that the data and the papers can be made available from the funding council.

Chairman] We already have them, thank you, and they will be published in due course.

Lord Dixon-Smith

1355. May I just ask whether you have any thoughts on the second question as to whether your fellowships schemes are specifically linked to industrially relevant or clearly wealth creating research? This is one aspect that we have not touched on.

(*Sir Brian Follett*) It is a very fair question, my Lord Chairman. I do not think that we overtly linked our fellowship scheme to wealth creation. It so happened however that a quite significant number of the fellows are in wealth creating areas because we have made appointments in biotechnology, in computing science, in engineering, in the business school that are related very much to wealth creation. But I do not think that we sought it overtly.

(*Dr Carpenter*) But I think that we would claim, my Lord Chairman, that certainly either in the underpinning sense or in the directly relevant sense almost all the fellows that we have appointed in the sciences and the social studies will help wealth creation and industrial relevance.

Lord Phillips of Ellesmere

1356. If I may end with a question here, what proportion I wonder of the people that you have appointed came from the Royal Society scheme?

(*Sir Brian Follett*) Very few, my Lord Chairman. I think that I am correct in saying that it is either one or two. It is certainly true that as a result of this some other Royal Society research fellows have come to us and said, "We would like to transfer our fellowship to Warwick", and we have given on the whole warm support to that and we have felt obligated under those circumstances to offer those individuals the same terms of contracts and the same terms of employment when their Royal Society research fellowship ends.

1357. Is the problem with young social scientists that they are—I am not on very strong ground here—turned loose, so to speak, rather earlier than natural scientists? They do not work with senior academics it

[Lord Phillips of Ellesmere *contd.*]

seems to me for as long a period as natural scientists do. Is that part of the problem?

(*Sir Brian Follett*) You may be correct. I think that there is not a postdoctoral culture in the social sciences and it is interesting that the ESRC has only recently had a postdoctoral research fellowship scheme of the type that has existed at EPSRC or even as far back as SERC or the AFRC and all those things that we see in the natural sciences, and incidentally in the British Academy in the arts, were not present until very recently, so there is something out there in the social science culture. I think that we are trying to grapple with it. We do not fully understand it.

Chairman

1358. In part it is indeed lack of supervision, is it not, over the PhD—the complaints which are made by people in these faculties, the research students, that they are lonely, that they are unattended to, the completion rate in PhDs within the prescribed period was always very low and has been for a long, long time and has improved only recently, so it is really very, very different from natural sciences and engineering?

(*Sir Brian Follett*) Yes, my Lord Chairman, I think that you are right. Professor Newby was largely responsible for tightening up on the PhD success rate in this country, but there is a very fine book written by the present President of Harvard which outlines very clearly the issues that you raise, that the length of time to a PhD and the success rate of going to a PhD is very much dependent upon whether you work alone or in teams and this is largely the explanation for the relatively poor performance even in the United States universities in the arts and social sciences.

1359. Now are there any further points that you would like to bring to our attention? I think that we have touched on everything in principle. As far as the MRes is concerned which we have not got into in any length, are you a recipient of a pilot course of any kind?

(*Sir Brian Follett*) We have two. I happen to be chairing the BBSRC training and fellowship panel that created the model that the BBSRC is using.

1360. So that in, say, three years' time we shall find out exactly what the inquest produces in terms of judgment on all these courses?

(*Sir Brian Follett*) I hope so, my Lord Chairman. Certainly it is my intention, as the national manager of the BBSRC programme, that we will be putting in place beginning this October evaluation schemes continuously over the first two years to see how it develops. We are also going to try to produce some kind of boost to the morale of the entire national cadre by bringing them as a group to London and introducing them. We are also going to bring the managers of the ten degree programmes to London fairly regularly so that we can build up rather quickly some expertise because we have to come back with an answer to Government fast on this MRes. We cannot wait for a decade. It is a terrible waste of money. It needs either to be expanded or alternatively stopped.

1361. When you say, bring them to London, what does that mean?

(*Sir Brian Follett*) Bring them to the research council headquarters for a discussion between the individual groups of people organising the degrees as well as the students themselves.

Lord Craig of Radley

1362. Professor Newby and, indeed, others have referred to the importance of not being too rigid in setting the requirements of curriculum for the MRes. Are you of the same mind?

(*Sir Brian Follett*) Yes, my Lord Chairman, I think that we are of the same mind. What we are particularly interested in is if we wish to expose them to some dynamic business leaders, then it would be very sensible to bring them together so that we could have a day's session built round somebody from the pharmaceutical industry which would be applicable to all the BBSRC ones. After all, what we are trying to do, is it not, is very much to open up their horizons? It seems to me that that is what the vital component is, or one of the vital components.

Chairman] Thank you very much, Sir Brian, and your colleague. We are most grateful to you for coming to see us. Thank you very much indeed.

WRITTEN EVIDENCE

Evidence from AEA Technology

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

Advantages: In spite of recent changes there is relative security once established; level of pressure often at the discretion of the person; intelligent colleagues; flexibility in working times.

Disadvantages: Security (whilst not complete) can lead to complacency; little incentive to change to less-secure industry positions, even if these were available. This is not helped by uncertainty associated with industrial R&D including the closure of major industrial laboratories at short notice and giving only the legal lowest limit of redundancy pay.

2. *What are the advantages and disadvantages of the growth in short-term contracts?*

Advantages: Flexibility; possibly more positions available, as the risk to the employer is less. Also, research teams are refreshed by the regular injection of new blood.

Disadvantages: It becomes hard to take on projects with a longer time span (three years is not much good for a really innovative project which may take 10 or more years to reach fruition. This is, of course, why universities are often not ideal for big projects when they have to rely on student/postdoc labour forces. Coherent development and career structure very hard to achieve for the individuals involved.

Overall there is a need to set the balance right between long-term reasonably secure and shorter fixed term appointments and this requires careful informed management.

3. *How do you expect the situation to change in the next decade?*

Broadly down-sizing seems the mood of this decade, with many UK organisations seeking to gain benefit from the activity of others. The simple move to cost reduction evident in many sectors is not necessarily a move to efficiency or effectiveness, though there is plenty of room for improvements in the Research Council sector.

Internationalism may help, for the EEC investment is making a large difference (it is increasing relative to direct UK government spending). However, this certainly means that strategic direction is increasingly dominated by Brussels. It may mean too that more and more good staff move to Europe, for instance. New information technology is making international links easier.

Specifically in the academic sector there is a need for more effective focus and effective use of resources. This will inevitably require concentration into few centres in some areas with associated closures elsewhere.

4. *Information on destinations of those scientists who have left the contract research sector of academic science? (ie left untenured fixed-term posts?)*

We do not have details, but the small sample we know about includes (i) many who have emigrated, (ii) a few who have gone into banking and accountancy and (iii) a few who have moved to science-related jobs like science publishing, or (far more rarely) selling.

5. *What should be done to improve the mobility of scientists between academia and industry?*

There are two basic problems: *financial* (since people usually move to vacancies, rather than to posts newly-created for them, so there must be enough extra in the system to afford vacancies) and *social* (the ways of thought are different, but the difference is perceived to be even worse). Once again, the way forward is the elimination of the barriers in the way research funding is organised (despite the promise of the White Paper section 5.11, Government Departments still restrict greatly who may apply for what: implementation is very slow). Specific examples of ways forward might be:

(i) Schemes like the Royal Society Fellows scheme, in which someone would be funded (competitively) for five years (renewable for 10) to work in industry;

(ii) Schemes like the Japanese National Laboratory ones (AIST's Technology Frontier programme is an example) which support respectably large programmes for a fixed period (five years is typical; longer is rare, so they don't get fossilised) in which industry staff, academics and national lab staff work together. The emphasis is thus on the project (within a framework, actually not unlike the EEC framework) and on where it would be best done, not on the sector which might lead. In these cases the national labs have the scale, continuity and range to attack key interdisciplinary projects. There are some parallels with LINK, except that the Japanese approach seems to place much higher priority on getting it to work. Thus the Japanese see their national labs as an important asset and the industry involvement in Japan seems extensive (staff costs are paid by industry, but we suspect the space costs and many project costs are government-funded).

(iii) Adoption of nine months academic appointments as in US Universities where many staff, particularly in science and engineering take the opportunity to establish industrial links through short term visits.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade?*

Continued increases, especially in senior positions and more applied (industry) positions as (i) more role models are available and (ii) more positive career guidance goes (eg reduction in those lady academic advisers who still do not believe young women should do research, or school-teachers who feel it is unfeminine to be technically orientated).

What should be done to make scientific careers more attractive to women, and how?

Make sure they are aware of good role-models. This could be done by modest support to the several organisations (often learned societies) who have active programmes to do this. The objective should be to regard a scientific career as one of many normal possibilities, rather than one to be positively avoided.

Two areas which need attention are parents and the older, non-scientist, teachers, both of whom can have strongly discouraging attitudes.

7. *Assess the worth of the Government M.Res Scheme*

We support the introduction of M.Res degrees as a means of raising the standard of postgraduate research students. Introduction of such a degree is in line with best practice overseas; in the US, France and Switzerland. We regret that OST and the Research Councils are proceeding cautiously on the M.Res degree with a few pilot schemes initially.

Attached is a copy of the AEA response to Sir John Cadogan setting out the AEA views more fully in this question.

8. *Conclusion*

There is a perception that morale amongst university staff and research workers is poor. This is partly due to a continuing decrease in remuneration relative to other employers and an associated feeling of being undervalued. On the other hand, academic staff have not been faced with the massive disruptions that have been experienced by many people in industry associated with closures and redundancies. Nevertheless, the university system has been subjected to continuous pressures and changes in the rules that have led to uncertainty and confusion. Overall, there is a need for clearer strategic direction and leadership from the top—by Government, the UFC, Research Councils and the Vice Chancellors themselves.

6 January 1995

Evidence from Dr J Adams, University of Leeds

The University of Leeds welcomes the opportunity to provide evidence to the House of Lords Select Committee on Science and Technology Sub Committee enquiring into Academic Careers for Graduate Scientists. We have consulted within the University and our responses to the specific questions posed in the "call for evidence" are given in the attached annex.

The University of Leeds has, over the past 18 months, been spending some time in considering career development for Research Staff and the need for a firm institutional policy to address the career needs of Graduate Scientists. Our starting point has been a recognition of the numbers of young researchers in the system and the turnover in permanent academic posts. There are about 520 research staff at the University of Leeds (and some 1,150 academic staff) with an annual salary cost of about £10.5 million. Since, as the Committee's enquiry note recognises, most contract research scientists are dependent on short-term (circa three years) contracts the implication is that at least 150 of these research staff would be seeking new posts in each year. The University does not expect this many posts to become available by retirement, rather than by movement of staff between institutions, during the next decade.

If it is not feasible, under any realistic circumstances, to provide a coherent career for the majority of graduate research scientists within the academic system, then we must necessarily focus on maximising opportunities to enhance their employment potential in relevant and appropriate jobs outside higher education. Such mobility may, in any event, be a desirable national objective. A structured approach would focus on:

— enhanced career opportunities for outstanding young research staff;

— enhanced career development for all research staff.

Universities should add to existing research-specific training to enable research staff to make the most of their time in the University and to increase their employability inside and outside academia. Such an approach would build on training elements (related to the MRes) now being incorporated into post-graduate programmes. We would also encourage departments to require staff to take development courses to foster the competencies underpinning their research. We do not necessarily need to increase the training element already offered within the system but we may need to increase the extent to which the skills acquired within research are recognised as having a transferable value and satisfactorily validated. In this context, satisfaction must be to both the individual and to any potential employer. A structured career development programme (not *ad hoc* courses) including project and resource management, staff and personnel issues, personal and professional development and an appropriate validating system are now under consideration and will be instituted at this University.

In all this, we believe that it is essential to maintain a firm link between career development for the future and research activity in the present. We also need to establish a programme with manageable costs. Solutions to the career problem will depend, in part, on co-operation with the Research Councils and other research funders. If we want to establish an extended career track which includes development programmes then we will need to demonstrate the "added value" which offsets added costs. To combine these aims, and avoid distraction from primary research tasks, we need to put skills development into the "laboratory context". We therefore do not believe that taking staff away from the laboratory and putting them onto development programmes in other departments or outside the University provides an appropriate training environment. Unless we affirm the link between personal and career development within the research programme then the value of the career development approach is much reduced, because it appears to separate the research experience and the transferable competencies which we claim that research experience contains.

We are also establishing a Fellowships Programme to bridge between contract research and permanent academic careers. This programme will provide a number of research-only posts for outstanding young scientists, to provide them with a period when they can establish their independent research programme before moving to a permanent academic post within the University. To this end, the University will be making available some £1 million-£2 million per year for additional fellowships.

1. What are the problems and advantages of current career structures for academic scientists in the UK?

Contract staff recognise but do not always acknowledge the difficulty they will have in moving to a permanent post.

There is a dichotomy between the unstructured career progress of contract research scientists and permanent academic careers. Great resentment is felt by the younger cadre of scientists, who are constantly judged on their immediate past performance, when they contrast themselves with those in permanent career posts, where performance is judged by rather different criteria. This is demotivating to the younger scientists.

The advantage of the system is that, it provides a testing and selective environment which should lead to the subsequent employment of the very best academic scientists in higher education in the future. What is less clear is that the development period is structured in any way which encourages the best to realise their potential or to stay within the system for sufficiently long to make that potential available to the science base.

2. What are the advantages and disadvantages of the growth in short-term research contracts and academic science?

The advantage of the short-term research contract system is that it provides the science base with a large work force of able and enthusiastic young people upon whom our research programme now largely depends. This must have many advantages for the intellectual productivity of the UK

The disadvantages are that the numbers of short-term posts relative to long-term or permanent posts is so disparate that it is clear to most researchers that they are unlikely ever to acquire a permanent position. This breeds immediate discontent, but it also provokes a tendency for staff not to complete a period of employment and this in turn has a negative effect on the productivity of research projects and programmes.

The system tends also to favour the employment of younger staff. Older staff therefore see the need, if they do not obtain a permanent position, to move to employment outside the science base. The consequent intellectual drain away from the science base may be intentional, since it should more broadly benefit the economy, but if intentional then it should be more effectively structured. The casual loss of experience and intellectual capital is to the disadvantage of the science base. It may be preferable to move to a system where a smaller number of people were recruited each year and contract research employment was a recognised long-term track. To this end, it would be necessary for the Universities in applying for project grants to demonstrate the added value of older and more experienced staff through greater productivity or the potential to achieve objectives which could not be reached with new staff.

3. How do we expect the situation to change in the next decade.

It seems unlikely that there will be any changes in the situation in the next decade, unless the Universities and the Research Councils work co-operatively to make such changes to mutual advantage.

4. What information do you have concerning the destination of Scientists?

University of Leeds statistics indicate the destination of new PhDs as at January 1993 as:

116 students with PhD's in Science, Engineering and Medicine.
43 per cent to Universities, other HE and FE.
34 per cent Industry and Commerce.
15 per cent other employment.
8 per cent unemployed.

The timing of data of collection by HESA (and formally USR) does not lead one to expect that meaningful data for planning or analysis is produced. Information on completed PhD students is collected once each year and thereafter not again. As many go on to short-term University contracts for research, data should be collected three-four years on to acquire a more useful picture. Post-doctoral posts in Universities are increasingly regarded as a training period and some analysis of the destination of these highly skilled individuals should now be required.

4. What should be done to improve the mobility of scientists between academia and industry?

At the established scientist level it is rarely possible to move between academia and industry. Differences in pay scales and working practices militate against this desirable work pattern. The cultures are very different and it is difficult for any but the very best in industry to establish themselves in academia. Academics are regarded industrially as "too old" once past 40 unless they move into Senior Managerial positions. Short-term mobility is impossible due to the extended time required to build-up a team and programme unless huge resources are made available in a short period. On both sides, a period out of normal employment is seen as deleterious to long term career prospects.

5. How do you expect the situation concerning women in science and engineering to change?

There is need properly to address the need of women in their 20s and early 30s to take structured career breaks in order to start a family. The attitudes of the Research Councils and other research funders to covering such periods is unhelpful. There is a disincentive for grant holders to employ women who they "suspect" might be likely to start a family in the near future. The loss of intellectual quality is reprehensible and the potential of women scientists which goes unrealised is a national disgrace.

6. The Government's MRes degree will be pilot from 1995. Outline your assessment.

The University of Leeds has a post-graduate training development programme now being piloted through the Enterprise in Higher Education Initiative. The MRes highlighted the need for training in generic skills for research students and that is beneficial. However, as an end in itself the MRes is a "stand alone" qualification and does not appear to be needed by many employers. Resources and effort might be better directed to achieving an improved PhD degree with validated transferable skills. The pilots will be expensive in terms of effort and resources for a small number of students. It is unlikely to appeal to the very good students to whom a "wasted" year may be a disincentive.

Evidence from Sir Geoffrey Allen

I. The current career structures for academic scientists in the UK still offer the same problems and advantages as they have done for the past 40 years with the possible exception of the period from 1965–70 when there was a considerable expansion in the number of science departments and the complements of individual departments. The problems of embarking on a scientific career are:

1. The competition is very strong.
2. The rewards for many years and perhaps for the whole period of service in terms of salary etc are small.
3. One has to demonstrate proficiency both as a teacher and as a research worker. The emphasis on being an effective teacher has grown considerably in the last 20 years. The advantage of the current career structures include:
    - i. The need to be completely committed to the career path.
    - ii. For outstanding people, there is the prospect of relatively higher rewards than in the past and the emphasis on the exploitation of research means that an increasing number of academic scientists have incomes from patents or industrial activities.
    - iii. Perhaps the biggest advantage in the current structure is that it is now possible by means of a Royal Society Research Fellowship to spend five years establishing ones research position and becoming part of an elite pool from which many of the tenured appointments are made. In some respects a junior lecturership and then a Royal Society Fellowship has advantages over an Assistant Lecturership and then a period as a probationary lecturer had in the old days.

An additional feature in the current system not having as much emphasis in the past is the possibility of moving with the exploitation of ones research to begin a second career in industry. There is also the possibility of using (prudently) industrial and commercial income to supplement academic salaries.

II. There are no particular advantages or disadvantages to the growth of short term research contracts in academic science provided one understands clearly the purpose. Research contracts are given to get research done in academy and not specifically for the purpose of providing rungs on the ladder of an academic career.

It might suit a scientist determined to pursue a career in academy to take a research contract in academy as his first step provided the rest of his career is destined for the transfer to the career structure mentioned in question 1. The disadvantage of the growth in short term research contracts is that post doctoral workers are encouraged to take a succession of contracts which then leave them stranded.

It would make sense for Research Councils not to allow a scientist to have more than two to three periods on a short term research contract. If Departments manage the balance in short term contracts and young members of staff fully integrated into a career structure badly, then there is a danger that the quality of research in the department may suffer. That is to say the balance of work may swing too far towards problem solving rather than curiosity driven research and extending the frontiers of knowledge.

III. My expectation is that in the next decade with the current age structure in full time university posts, retirements should lead to a reasonable number of vacancies. If this pool of vacancies is properly managed within departments and within individual universities there is a good chance of having well balanced departments with good quality people and a lower average age. The pool of Royal Society Fellows already in post should provide scientists of quality for many of the tenured appointments becoming available.

The outcome turns on how well individual universities manage themselves and the quality of leadership in the individual science departments. The quality of leadership in a department has never been at a higher premium than it is now. This is due in part to the increased proportion of funding in science departments which comes from industrial and commercial sources.

The supply of academics of high quality is primarily the function of the Higher Education Funding Councils, the Royal Society, the Royal Academy and the Royal Academy of Engineers. The Research Council system has now fairly and squarely taken on the task of identifying research of national importance and making sure that it gets done properly, with appropriate interfaces into industry.

IV. I have no specific information on the destination of those scientists who have left the contract research sector of academic science. However my experience in Unilever left me with the clear impression that we did not usually find our outstanding recruits in this pool. We tended to recruit the best people immediately after graduation or fresh from a PhD with a few who were prepared to leave their academic career early and move into industry.

V. The only obvious improvement that can be made by legislation to the mobility of scientists between academy and industry is to ensure full portability of pensions. My experience is that moving from academy to industry is relatively easy because industry will often make up some of the difference. With the present arrangements, moving from industry to academy is much more difficult unless the incumbent is prepared to reduce his expectations.

Other factors which influence the mobility turn on the quality of management in industrial research and the stability of industrial R&D budgets. Likewise the mobility of scientists from industry to academy in the UK is beset by the lower salaries in academy. From 1981–90 this was not the case in the laboratories that I supervised in the US, Holland and Germany.

VI. Most of the actions which can be taken to make scientific careers more attractive to women have now been taken. Time to allow old attitudes to melt away is perhaps the biggest obstacle. I believe we have a very enlightened attitude to solving this problem and the number of women in science is steadily rising and may well take a sharper upward turn in the decade 1995–2005. The two most stubborn problems are the mobility of a wife and family and the fact that many wives cannot for understandable reasons make the adjustment required even in a reasonably benevolent system unless they have a husband equally committed to solving the domestic problems.

VII. The proposed M Res degree did not find much favour among scientists and technologists. I was not persuaded that there was a need, provided there was emphasis in the current postgraduate courses on properly assessed taught courses for those reading MSc and going on to PhD and well structured vocational courses for those who wish to acquire an MSc or MEng. I would rather have had emphasis placed on improving the quality of the existing system than the diversion of having to create a new degree, the content of which did not seem to have been thought through. There is no objection to a pilot scheme but in the circumstances it is likely to be taken on by departments less well equipped to do top flight research, which means that the outcome is not likely to be beneficial.

30 January 1995

Evidence from the Association of Department of Health Funded Research Workers

BACKGROUND

1. The Association is a forum for researchers to express their views about issues of concern to members and represents the researchers in discussions with the Department of Health. During the last three years the focus of the Association's activities has been the response to the Williams Review of Department of Health Funded Research Units in 1992. The Association has held a series of general meetings, set up a Working Group, produced a number of papers and has been engaged in an open correspondence with the Department.

2. The Review's report recommended radical changes to DH funded units. The acceptance of this report has resulted in a period of great uncertainty for researchers. The effects of "planning blight" during this period has been detrimental to health and personal social services research. In particular there has been a drift of senior researchers away from Department of Health funded research.

3. This has exacerbated an already acute problem: the dearth of middle and senior researchers especially in certain disciplines such as health economics. The problem has been noted by a number of observers and was described in the Review of NHS Research and Development led by Anthony Culyer.

THE NEED FOR A CAREER STRUCTURE AND COMMITMENT TO RESEARCH

4. To assure the future of health and social services research considerable investment is needed to maintain and develop a suitable workforce. The enclosed paper *A Career Structure for H&PSS Researchers* summarises many of the issues from the perspective of researchers. The Department of Health has demonstrated its concern by launching the Research Workforce Capacity Initiative. We welcome this and look forward to the recommendations particularly with respect to training, staff development and terms and conditions for research workers.

5. We support the Culyer Report recommendation that there should be an expectation, indeed requirement, that an allowance is built in to any research contract of reasonable size for training and staff development.

6. Institutions (usually Universities) need to demonstrate that they have a policy of providing adequate terms and conditions for contract researchers. The enclosed paper describes the unsatisfactory routine application of waiver clauses regardless of the researchers level of seniority or length of service in an institution. Employment insecurity is therefore the norm.

7. The ESRC is moving in the direction or requiring institutions to demonstrate a commitment to researchers on their staff and there has been some discussion by the Science and Engineering Base Coordinating Committee but on the ground there has been no evidence of coordinated action taking place.

THE ADVERSE EFFECTS OF COMMISSIONING RESEARCH BY COMPETITIVE TENDER

8. We are very concerned that the good intentions behind the recommendations of the Research Workforce Initiative will be undermined by the dramatic increase in the proportion and numbers of Department of Health and National Health Service research projects that are funded through competitive tender.

9. These tenders need to be submitted by the very individuals who have been identified as being in such short supply. Increasingly the time of such researchers is spent in submitting tenders or in reviewing other people's bids. As a result, the amount of time available to actually undertake or supervise research or investment in training and development of individual researchers is diminishing.

10. This is an inappropriate use of such a scarce resource and there is great concern within the research community about the level of waste and inefficiency because of resources committed to unsuccessful bids. Nevertheless we appreciate that in terms of EC regulations this problem is not likely to disappear. Awareness of the problems and approaches to resolving these need to be built in to the tendering process. Otherwise there will not be the staff available to do the research.

CONCLUSION

11. A period of insecurity caused by planning changes has exacerbated and made more evident the problem of maintaining and developing a sufficient "technical infrastructure" of academic scientists in a variety of fields. The current tendency to commission research by competitive tender may produce at best short term gains in commitment but is likely to produce a reduced market of researchers and further leakage of staff from academic institutions. In order to arrest these trends a career structure for research needs to be created and supported to maintain the UK's position in this field.

Evidence from the Association of Graduate Careers Advisory Services

The Association of Graduate Careers Advisory Services welcomes the opportunity to submit comments to the Select Committee. In the short time available it was felt to be more useful to the Committee to consult a selection of careers advisers who are advising science students on a daily basis. Responses were received from careers staff at Birmingham, Cardiff, Cambridge, Edinburgh, Oxford, Reading, Southampton, Warwick and Queen's Belfast. Their comments follow.

Question 1. Problems and Advantages of Current Academic Career Structures

The PhD system selects people very well for academic careers but is less useful for industrial careers, except where industrial research is of the same nature as academia. Lack of opportunities in industry (see Question 5) can deter young scientists from starting PhDs and, even more, from taking post doctoral fellowships.

A major disincentive to an academic career amongst young graduates and research students is the combination of poor pay and poor working conditions within academia. The latter can be defined as lack of good modern equipment and laboratories and a lack of assured research funding—ie the continual need to reapply for funds—see Question 2 below.

Undergraduate scientists are exposed to low morale level in researchers, especially linked to ever increasing work on grant applications with decreasing chances of success, and are choosing alternative directions.

Moreover, many postdoctoral fellows feel undervalued and isolated. They often express dissatisfaction at the "cavalier" way in which their employment is handled. Their funding council, as employer, simply eases payment at the end of a contract and no communication/recognition of any kind is forthcoming. This is particularly alienating in a recessionary employment market.

The bottleneck at lecturer level is not alleviated by a parallel structure for researchers.

The main problems of the current career structure for academic scientists in the UK are short termism and (more importantly) a lack of training, which is probably related in that appropriate training may be difficult to identify and uneconomic to provide. Short-term contracts inevitably drive down the price of researchers and so most are obliged to quit the groves of academy in their early thirties when they become too expensive. They do so with—in many if not most cases—real problems of assimilation into the world of non-academic sciences, lacking the management skills (in particular) that are essential in that world. This training and experience gap is the key problem rather than short term contracts per se. Individuals, of course, put off training considerations: the pressure to produce results to contract can be high, and "after all, it's only for a year or two. . ."

The advantages lie almost entirely with the University concerned and with the funding body (if different). The disadvantages are inefficiency—wasting about 30 per cent of each three year contract. Working your way in at the beginning and looking for the next contract at the end. The need to humour your boss, as you will soon need a reference, even if this means suppressing your own scientific initiatives. The impossibility of doing any medium term career planning and the resulting instability. Many good scientists give up at the peak of their innovation curve because of this.

The main problems are:

(i) Academic salaries have fallen far behind industry.

(ii) Early retirement programmes are not used as much as in industry to allow the recruitment of younger academics.

Our feelings on this issue focus upon salaries in academic institutions which are not competitive or comparable with those offered in industry. In general career structures within industry let exceptional employees scale the promotional ladder much more quickly than their academic counterparts.

Advantages—many talented experienced people available at low cost when needed.

Disadvantages—uncertain career path, temporary contracts. Has grown up because of cut-backs in academic posts; each scientist trying to build up a useful portfolio. Maybe dashed expectations/less useful skill base for other careers options.

Problems—large number of postdoctoral fellows are being produced, particularly in life and physical sciences. Fixed term projects mean that research staff move from one postdoctoral contract to another every two to three years, eventually pricing themselves out of the market. Many go into jobs which they could have entered years before or indeed change direction altogether. The constant moving and financial uncertainty of this style of employment also has repercussions on their personal lives.

Advantages—freedom to gain relevant experience in different institutions. Cross fertilisation of ideas in their specialist area.

NB. Fixed term contracts in industry look set to duplicate this situation in the private sector.

QUESTION 2. ADVANTAGES AND DISADVANTAGES OF GROWTH OF SHORT-TERM CONTRACTS

For the really talented (by definition the exceptional) short-term contracts provide varied experience which benefits their academic career and the community generally.

However, a major disadvantage of the growth in short-term research contracts is the need continually to reapply for funding (see 1 above). Some funding should be available for long-term research, particularly in research-orientated universities, and this trend cuts right across that need.

Short-term contracts arise from lack of finance and the lack of long-term vision by those who place the contracts. They therefore cause would-be scientists to defect or to specialise so much that they cease to be versatile—especially in life sciences. Life sciences in particular have a tendency to the "cul-de-sac" trap. The intense and ever-narrowing focus of research projects, coupled with rapid advances in the field, is subject to sudden changes in approach and funding which leave researchers stranded and "obsolete".

Post-doctoral scientists find the requirement to move every two to three years socially disruptive, adding to insecurity.

There are serious financial implications for those on short-term contracts; (lack of access to loans, mortgages etc). Coupled with the low salary levels compared to other career directions, academic and research careers aspirations are often discarded.

Those employed under short-term contracts have little or no access to wider career training and development (eg that might make them more attractive to industry). This also relates to Question 5.

Short-term contracts may be satisfactory for young graduates, but are a real disincentive for people aged 30 plus.

Short-term research contracts may allow a large number of people to get both experience of research methodology and research, therefore acquiring skills valuable to both industry and academia. However, contract-led research projects can also thwart academic freedom to pursue personal interests in specific academic areas, the result being that the knowledge base is led by industry's needs alone and not by the inquiring minds of scientists.

The only advantages are that less than competent "managers" of university departments and funding bodies can remain less than competent, as their mistakes can be rectified every three years. The idea that you need short-term posts to manage human and financial resources in a climate of change is nonsense. All that contract posts do is to remove the need to confront issues between the start and finish of the contract. Similarly, funding bodies can change policies every three years without upsetting too many people.

The disadvantages are more of the same—see answer to Question 1.

Disadvantage—we are seeing many more PhDs/Postdoctoral biologists who want to leave science because of the dependency on short-term contracts, ie very unstable life.

Short-time contracts do have some advantages. They provide a useful way for people to move between related fields of work without too much need to explain why (everyone understands the bread-and-butter need to scrabble for new contracts) and so can be good for individual flexibility. I can recall individuals who have benefited from short-term contracts in moving from fundamental science to more marketable applied work with low risk both to the individual and "the system". Mobility is another advantage in some circumstances: the growth in short-term contracts allows people to link personal circumstances with academic objectives fairly easily. But the downside of academic and geographic mobility is the risk of the researcher being typecast as a jack-of-all-trades.

It should be emphasised that, by definition, a person on short-term contracts necessarily spends a high proportion of his/her energy and time on looking for the next one or writing proposals. That must introduce significant inefficiencies into the system.

The twin problems of isolation and lack of personal training and development are, therefore, those that need to be addressed rather than that of short-term contracts themselves.

QUESTION 3 FUTURE CHANGES IN THE NEXT DECADE

More of the senior university posts will become untenured, forcing academics to work in other spheres. Some will be very successful but for others it may have tragic results. This is as a consequence of increasing short-term funding and the demise of true fundamental research outside the universities in this country. Talented academics will increasingly move to societies where there is more opportunity and stability eg: in continental Europe and North America.

There ought, of course, to be an increased demand for academics to replace the large group coming up to retirement and to fuel the expanded university system.

I expect the growth in contract posts will increase as there is little evidence that universities are getting better at managing their resources, or that funding bodies are likely to change their policies. The quality of research scientists is likely to drop as the rest of the job market slowly improves.

Demographic trends suggest that a large cohort of senior academics will retire over the next ten years. While constituting a loss of experience and expertise it should allow for opportunities for younger academics to come through into University Departments as those senior to them fill vacated senior academic positions. Salary and careers structures must be revised in a way that attract young academics, particularly women. There is also a danger that the perceived centres of excellence will recieve disproportionate amounts of funding thus limiting other competent and developing academic departments in the development of both their research and staff.

Ageing academic work-force; extent to which the bottle-neck will be relieved is dependent upon government policy regarding teaching/research roles of universities and the availabilty of external funding.

In the next decade it is obvious that a good number of senior academic scientists will retire. This is certainly happening here (I never fail to marvel that so many of the people who had the misfortune to teach me here 30-odd years ago are still around) and makes way for a younger generation but, of course, many institutions are deliberately managing costs and age structures and, it must be said, performance via contract employment. The "new" universities are increasingly competing for research funds as well, and the net effect will probably be a modest unlocking of career structures in the short and medium terms. But the risk of an avalanche of posts is not high.

Some departments eg physics have a very "old" age profile for academics, but given the length of a working career placement of academic staff will not make a significant impact on the numbers of post-doctorals seeking work. Indeed, as resources are squeezed it is quite likely that the staff/student ratio will increase. The use of new interactive multimedia computer technology for teaching could be important in this respect. Also we are seeing more teaching duties being put into lower graded posts at university and even into temporary research posts. These changes would seem to suggest that there may be even fewer full-time permanent academic posts in future which would help universities to remain flexible and so be able to "balance the books".

QUESTION 4 DESTINATIONS OF SCIENTISTS

No statistical information available. Anecdotal evidence not conclusive but mainly to jobs outside research. We have noticed many PhDs moving to the City where starting salaries can be £23,000 to £25,000—incomparably higher than post-doctoral salaries.

No information kept but IMS report "The Demand for PhD Science Graduates' says 25 per cent of PhD recruits were post-doctoral rather than newly qualified PhD students (page 8).

Destination data are anecdotal only as far as I am concerned. On the one hand, most of the research staff members I see—and in fair numbers—seems to get fixed up relatively quickly, usually in research jobs but sometimes in "any discipline" jobs. A quick check reveals that almost all are in the 28 to 33 age bracket. But I worry that those I see represent the more dynamic, outward looking fringe. About four years ago I ran some career development workshops for research staff. I was frankly taken aback by the sheer extent of the problems being faced by older researchers whose academic careers were clearly over and whose prospects outside seemed to them to be bleak.

Not much. Mainly restricted to those disenchanted holders of contract posts who want to get out of the three year cycle. Many are so fed up with the mismangement of scientific research that they want to leave science altogether. Many go to the City, software consultancies, etc.

No detailed information, but much dissatisfaction from individuals unable to find permanent posts.

Except for contract research scientists who complete PhDs, we do not hold statistical data in the format required by this question.

QUESTION 5 IMPROVING MOBILITY BETWEEN INDUSTRY AND ACADEMIA

The mobility of scientists between academia and industry is difficult for various reasons. In the first place, industry is very bad about recruiting scientists and using them. It is noticeable that most of the young who reject an academic career for the reasons given above, reject an industrial career albeit for different reasons. There they quote the constraints on research as well as poor pay, compared with other functions. Equally, industry has totally failed to take advantage of the disillusionment amongst many young university scientists. Recruitment has been sporadic, short-term in its time-scale and uninspired in the message which it gives. The net result is that many good young scientists and engineers are lost to research, thus reducing the size of the pool which could be mobile between the two worlds.

Furthermore, opportunities for transfer are reducing as industry places more of its research in universities. Exceptions are pharmaceuticals and electronics areas and PhDs also seem very useful in some smaller high tech companies, though often the range of opportunity is limited in terms of scientific growth.

For those postdoctoral fellows who would like to enter industry, after two postdoctoral contracts, and frequently after just one, many industrial organisations automatically reject applicants as too "academically orientated".

There is a need for a specific academic training for the "development" function. The Msc or perhaps the MRes should serve this purpose. PhDs should not be used for more applied work for which some other training is probably more suitable, though this is a path that many of them feel forced to take.

Sponsorship of undergraduates, assistance with their final year research projects STEP.

Sponsorship of post-graduates, CASE awards, setting out of skill guidelines, relating research to industrial concerns. Increase in Teaching Company schemes.

Involvement of careers advisers in a more systematic way with PhD students.

Integrated Graduate Development Schemes (IGDS) eg (Warwick) encouraging University/Industry collaboration.

4th year Engineering Doctorate schemes; involve issues of project management, industrial relevance and taught courses. Students spend a significant proportion of their time within industry helping to solve engineering programmes.

EPSRC Graduate Schools (Personal Career Workshops for PhD students) are valuable.

It seems essential that better education/industry links be established so that both parties can ascertain each others' expertise and general research needs. Additionally, we must look to encourage small and medium-sized businesses to link with academia with reference to research and development. To assist this development, the expansion of Teaching Company Schemes and secondments of academics into industry and vice versa may be a positive step in the right direction.

Industry usually recruits people under age 30. Industry also looks for good Personal Transferable Skills, which all universities should develop in their courses.

More collaborative projects. Align the styles and goal-setting systems. Have more secondments both ways.

Increase in the measures already being taken by the research councils eg increase in collaborative ventures, CASE awards etc. More opportunities in industry for new PhD graduates—currently most advertisements ask for two years' experience. More flexibility on the part of industry as the experience they are looking for in a PhD graduate—at present they can afford to be very specific because the supply is plentiful. More collaboration generally between industry and academia should be encouraged. For mobility the other way round, ie from industry to academia, and then salaries would be a stumbling block. Perhaps industry could help in this respect by funding any difficulties in salaries involved in, say, an exchange of scientists for a fixed period?

QUESTION 6 WOMEN IN SCIENCE AND TECHNOLOGY

Undergraduates, especially women tend to be more forward thinking in their choice of degree subject, frequently indicate encouragement from school and family to go for professional and vocational options, rather than pure scientific ones, because they offer better career prospects.

One of the main disincentives to women to make a career in scientific research (whether in universities or industry) is the intensively competitive and relatively inflexible nature of the scientific environment. Young scientists particularly are expected to work very long hours, to be very dedicated and not to take career breaks. This atmosphere is particularly off-putting to women, though it has to be said, also, that it is increasingly unacceptable to men.

Career breaks for women are almost unheard of in the sciences. Female students frequently raise the lack of career breaks as a serious disincentive together with the almost total lack of part-time work or job-sharing arrangements. This is often perceived as a reactionary workplace culture and both undergraduate and postgraduate women cite this as a potential difficulty.

Good maths and physics teaching all the way through from primary school essential. Presentation of positive images. Opportunity 2000 and the Commission on University Career Opportunity are addressing some of the broader issues.

Industry is better than academia at promoting equal opportunities for women. Scientific careers are not attractive to men or women as career opportunities have diminished compared with industry and the financial services sector.

Schools must be responsible for marketing the Science "A" Levels to female pupils, a role which should be supported by the scientific sector via school visits etc. Companies must market themselves and structure themselves in such a way that attracts women to apply. Government should be prepared to fund one year University conversion course for those coming from non-traditional "A" Level science subjects to study Engineering, Technology etc, particularly women. Without such measures ie industry attracting women applicants by restructuring hours of work etc and Universities being allowed to recruit women from non-traditional subjects, the position of women in science, engineering and technology may not change significantly in the next decade.

Not much change anticipated. The gender stereotypes between "hard" and "soft" sciences and between "pure" and "applied" sciences are likely to continue. In time, if very much better science teachers are recruited by schools they will start to effect a small change in the ratios. Not much sign of this happening yet.

Another, related issue is that many women want to "establish" themselves in their chosen career before having a break for children. In the three year cycle, they do not see this as achievable so they opt out and are often lost to science. More "permanent" jobs in scientific research would encourage more women to stay. Making it easier to hold such jobs on a part-time basis would be even better.

Dual career issues present serious problems in academic environments. The limited opportunities at a national level and the exceptionally competitive nature of the sector, linked to poor provision of flexible working patterns, effectively discriminates against, and discourages women. Finally, schools will have to make science exciting as a subject to women as they once did for men.

The supply of women science graduates in some disciplines does not seem to be a problem (eg life sciences, chemistry). Proportionately fewer women enter Engineering and Physics courses but this problem really needs to be addressed at the school level. The main problem for women scientist comes once they are in employment when they seem to fall behind. Science employers tend not to give career breaks (which would cause a problem in terms of keeping up to date with current research) or offer part-time work.

QUESTION 7 THE MRES

In theory, the advantage of an MRes degree from a career point of view (as opposed to whether it would provide a better foundation for subsequent specialised research) is that it might give more people a chance to try research for a year without having to make a long-term commitment. For universities it might provide a better means of identifying true research ability. There is, however, a risk that this will inculcate a feeling of failure in those who are not selected.

The MRes should definitely *not* be seen as a second class option but it is in danger of being perceived in this way. It is seen as a money-saving device largely. If the system is to operate positively it must be funded to allow more people than at present to do one year of research, although possibly it might be more selective about who it allows to continue. It would have to be accepted, however, that this would be very time-consuming and disruptive from the point of view of academic supervisors, even though it might be better from the point of view of the graduates.

Another disadvantage might be that, in a mixed system, universities which did not insist on an MRes might be at an advantage in recruiting students who wanted to get their PhD as quickly as possible. Unless the system becomes compulsory, it will have to offer clear advantages if those universities which adopt it are to compete successfully with those who do not.

What benefits will an MRes have over a MSc by research in the eyes of Students/Universities/Employers? Will they be extra degrees? If so, how will they be funded?

The original concept of a preparation for a less narrow PhD was good. However, it has evolved as a bolt-on extra to the same style PhD. Four years instead of three, same total of money in the pool leading to fewer PhD awards. Maybe this was always the hidden agenda.

A graduate with an MRes who does not proceed to PhD will be regarded by employers as a failed PhD candidate. It looks as though the Government is back-tracking on the MRes. Only a few university departments will offer them, often those which want to increase their total of postgraduates because their research record is less than excellent. The MRes will be optional. Most graduates will not opt to do one. It has to be compulsory if the idea is to work as originally intended.

The MRes degree may assist people to decide if they really want to do a PhD. Some students are persuaded to do a PhD without considering the alternatives.

We felt, in general that it would be better to incorporate modules of research methodology and analysis into current PhD programmes, for example, by having a summer bridge course be supplemented by taught lectures or further courses during traditional vacation periods.

We don't see any particular advantage in the introduction of MRes Training in research methods should be part of the PhD. In many sciences training in research methods without the three years' research practice could be of little value to the individual.

A longer PhD could put a student off going into research. As no extra research money has been proposed the number of PhDs would be reduced. From a careers point of view, it is welcomed that transferable skills are being recognised as important by the powers that be, but couldn't this programme be incorporated within the current three year PhD? Separation of the MRes from the PhD is likely to hasten the development of "first" and "second" class institutions by granting or withholding an institution the funds to run an MRes.

Note It is clear from these comments that careers staff observe the effects of current policies at first hand and have spoken to many young scientists and technologists who are concerned about their own futures and the future of science and technology in this country.

31 January 1995

Evidence from the Association of Medical Research Charities

The Charities Contribution to Medical Research

1. The Association of Medical Research Charities represents 85 member and affiliated charities. Their contribution to United Kingdom medical research has grown steadily in the past 10 years and in 1993–94 amounted to £317 million.

2. The majority of medical research charities raise money from the general public and support research into a single disease or group of diseases. Their contribution to medical research should be understood within the limits set by their individual charitable objects. Charities are not free to redirect their support to areas which may be seen by some as having a higher priority but which are outside their own charitable objects.

3. The work which research charities support is undertaken largely in institutions which are themselves mainly funded from government sources: Higher Education Institutions (HEIs) and NHS Hospitals with the far higher proportion going to Universities (Chart 1). Within these institutions charities rarely direct or commission research: their contribution is largely in the form of responsive support for research for which HEIs, their staff, or NHS staff seek funding. Most of the funding is in the form of short term support for specific research projects, fellowships and other similar styles of funding. Some charities have funding schemes which offer longer term or more general funding, for example in the form of core grants for departments or units, the support of named or endowed Chairs, or rolling programme grants. There are a few charities which support research in their own independent units.

4. The attached matrix illustrates the different funding types. The major part of the funding from AMRC charities is within Level 3 on the matrix, ie short term support for specific research or individuals (typically two or three year awards). This type of funding enables charities to target their support for research to proposals of relevance to their objects. There has been an expansion in recent years of research initiatives which fall within Level 2, and this is particularly true for the life sciences. Some of the larger charities have been able to contribute to this process by providing substantial commitments for new initiatives, to units and departments with HEIs or the NHS or substantial longer term support for named Chairs or departments. However, for the majority of charities this style of funding is not a realistic option as they are either too small or their income too uncertain to undertake long term or substantial commitments to one research proposal. The Association considers that funding for Level 1—Infrastructure Support and long-term careers is the responsibility of Government.

The Medical Research Environment

5. The medical research charities are concerned that the medical research environment in the UK has become increasingly unpredictable in recent years. The current period has been one of substantial change in both higher education and the NHS. For research to thrive the environment must be reasonably stable and predictable otherwise long term planning cannot be carried out. Those partners in medical research should be kept fully informed of developments which are likely to affect the way in which they support research.

Higher Education Institutions

6. Whilst the Association appreciates the need for change it believes that the difficulties which rapid changes bring about for research funders has not been acknowledged. Changes in the funding of university research introduced in the last five years have created an unstable and uncertain environment for medical research funded by charities. Nearly 60 per cent of charity support is at present spent in universities across a wide range of subjects.

Medical Researchers and Careers Issues

7. A broad range of professions are involved in medical research. The charities within the AMRC currently are supporting around 4,500 individuals in research including clinicians and basic scientists, support staff and professionals allied to medicine. The charities support senior appointments as well as training posts and short term research posts. Nurturing this principal resource of medical science—the people—is regarded by the charities as being of the highest priority.

Initial Steps

8. Medical research must attract sufficient numbers of able individuals from which to draw its career researchers and shorter term contributors. There is some evidence that suggests that sciences and medicine are no longer so attractive to school leavers and that good medical and sciences graduates may not be attracted to research. Part of the latter problem was undoubtedly linked to the poor remuneration given to postgraduate students: in 1988 the Association addressed this issue by recommending a minimum stipend for postgraduate studentships which now stands at £7,000 (with a review pending). Although some PhDs are acquired through part-time study or whilst working as research assistants, the Association believes that a significant proportion

should complete a period of full time study. Members of the Association, although having a primary interest in research, have recognised the need to have a sufficiently large pool of scientists undertaking research training. 33 charities currently support some 774 PhD studentships in the UK.

9. The majority of the studentships supported by charities are for a fixed three year period. The Association fully supports the principle of training in basic research methodology for all students but does not support the proposal for an MRes degree prior to a PhD. Many universities already scrutinise the qualifications and training of prospective candidates and register them for an appropriate degree. In some universities PhD students are automatically registered for an MPhil and only upgraded to a PhD registration after satisfactory completion of the first year. For PhDs in the medical and life sciences there would appear to be little evidence to support a radical change in the current arrangements. Charities do not intend to fund MRes degrees but some may be prepared to fund a four year course PhD.

10. The Association would be concerned should a two-tier system of PhD studentships emerge if charities only support what is perceived as a faster (shorter) route to a PhD. Charities will follow the results of the proposed pilot scheme with interest but doubt if it will be applicable to most scientists undertaking medical research.

Careers in Research

11. The Association believes there is a need to offer young scientists the opportunity of a career in research if they are to be attracted beyond the first one or two years after post doctoral research. Major difficulties exist at this stage for both medical and non-medical graduates.

12. The paucity of long-term career posts in universities forces many researchers to continue their careers supported on a series of short-term appointments or to leave scientific research altogether. The balance between short-term funding and long-term opportunities appears to be wrong but the provision of long-term support presents particular difficulties for the "collecting tin" charities which, in general, fund grants from recurrent income rather than from endowments or interest on capital. For such charities five years is "long-term" in financial terms. The few charities which are able to support research workers in the longer-term (for example, through "rolling" appointments or endowed posts) such as the Wellcome Trust, Imperial Cancer Research Fund and the Cancer Reseach Campaign, help to ease the problem but cannot overcome it. We would want to encourage charities who are able to do so to increase their long-term commitments, but Government must appreciate that the current uncertain situation in universities and the NHS makes this exceptionally difficult at the present time.

13. The whole issue of retaining scientists in medical research (clinical and non-clinical) needs to be considered collaboratively by all those with interests in the science base. Although charitable income to universities may increase over the next decade (and this is by no means certain) charities will never be able to make more than a minor contribution to long-term career security. It is therefore vital that universities and other Government funding agencies get together with charities and with industry in order to plan a proper career structure for the graduate scientists who are so vital to medical research. It was put to us by the Dean of a Medical School that the School could create the long-term posts if the charities could support the training and short-term projects. Such a scheme is only possible with the closest collaboration of all parties.

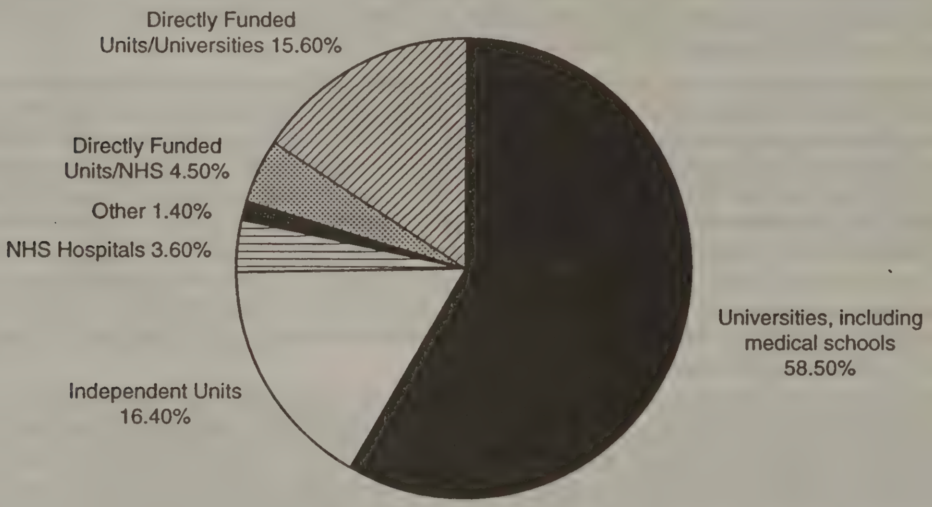
14. We argued in our submission to the Chancellor of the Duchy of Lancaster on the future of the UK Science and Technology for a Standing Committee to be set up to consider the needs of research (including the careers of graduate scientists) at every level of planning and at a practical level. Such a committee would bring together those sectors with an interest in UK medical research but would not need to infringe the independence of any of the participants involved. The forum proposed by the Culyer Committee on Research in the NHS should be able to address the issue of careers for clinical academics but is unlikely to be able to tackle the wider issues of careers in universities and industry.

15. The Association has not yet discussed the specific problems of retaining women in medical research. Whilst charities would undoubtedly be sympathetic to the needs of women for part-time work, maternity leave and child-care facilities, they would regard the provision of these resources as the responsibility of the employing authority and most would not be in a position to meet the additional costs. This issue further emphasises the need for collaboration and discussion between HEFCs (and other employing agencies) with charities in order to ensure that the important contributions made by women to science is not lost.

	Research Institutions		
Types of Funding	*Universities*	*NHS*	*Independent Units*
Level 1—Infrastructure eg Premises (inc maintenance and insurance) Basic equipment Basic secretarial and technical support Basic services, eg glass washing Libraries Telephone, central administration Academic staff	Funding Councils—HEIs block grant Industry—in full cost commissioned research Government Departments in full costs commissioned research	SIFTR SHA funding Non-SIFTR scheme General NHS funds (service element) Industry—full cost commissioned research	

		Research Institutions	
Types of Funding	*Universities*	*NHS*	*Independent Units*
Level 2—Strategic facilities Longer-term commitments, eg Specialised facilities Specialised equipment Tied secretarial or technical staff Key laboratory support staff Key academic personnel Funding for large-scale clinical trials	Funding councils generic or directed funding MRC/Charity departments or centres MRC/Charity capital grants or donations; MRC/Charity endowment, funded chairs; MRC directed programmes; collaborative ventures (eg IMM); University private funds	NHS R&D directed programmes Cochrane Centre MRC/Charity departments or centres MRC/Charity funded consultant posts Donations to NHS Collaborative ventures	Charities own research centres (eg ICRF, CRC Beatson, Marie Curie) MRC units and laboratories Industry research establishments Other government research centres
Level 3—Short-term funding Specific research, time limited eg Project grants, fellowships etc Direct staff costs Identified direct costs such as consumables, small equipment	MRC/Charity project grants Equipment and travel grants Personal support, training fellowships Donations Industry	MRC/Charity projects MRC/Charity fellowships NHS local research schemes NHS R&D Industry	

Distribution of AMRC Funding for Medical Research in the UK



Evidence from the British Postgraduate Medical Federation

Thank your for your letter of 16 December inviting comments on the above issue. I apologise for the delay in responding.

My comments relate to the Sub-Committee's Questions one and two, which are linked. It may be useful to make some preliminary comments on the context in which UK academic science research is currently operating, viz:

— Typically, 70 to 80 per cent of a university's recurrent budget goes on staff salaries. It is often said by university leaders that staff are the most important resource of the university. In the research context, I think it is true to say that contract researchers are the lifeblood of universities. Hence, effective management of research staff careers seems to me to be an important aspect of the overall management of its resources by a university.

— There is considerable pressure on staff, arising in part from the three successive UGC/UFC/HEFC Research Selectivity/Assessment Exercises, to obtain research grant income and to write up results for publication quickly (preferably in time for the next Research Assessment Exercise deadline). However, the HEFCE has recently recognised the need to emphasise research "quality" rather than "quantity", and this recognition may be helpful in discouraging inappropriate publication practices.

— Increasing pressure on established academics to teach undergraduates means that, inevitably, they will have less time to train contract researchers in research methods, nor to help in reviewing or discussing the results and implications of their work.

- Academic research is charactised by relatively low levels of reward. For university contract researchers, low pay is compounded by the low prospects of obtaining an "established" post and hence (reasonable) security.

  Evidence of the fall in financial attractiveness of academia relative to other professions over the past 20 years will be clear by comparing current data on occupational earnings with the following data:

Median gross weekly earnings of full-time adult male employees, by selected occupation, April 1975

Occupation	*£ per week*
University teacher	97.3
Medical practitioner	92.0
General manager	89.4
Architect	83.5
Engineer, civil or structural	73.6
Primary teacher	70.9
Accountant	69.7

Source: Pears Cyclopaedia 1976, quoted in Snell, KDM, "Top of the jobs", The Times Higher, 2 April 1993, p 13

Taking the context that I have outlined into account, I think that the following quote from Lock & Wells (1993)[1] is apposite:

> "A researcher approaching mid-career becomes expensive to fund and dependent on seeming to continue to be both productive and innovative. The temptations are obvious . . .".

There seems to be scarcity of data on the prevalence of scientific fraud. However, I agree with Lock and Wells that there is a strong argument that, given the context of UK academic science, there is a likelihood that some short-term university researchers will be tempted to carry out research fraud. The existence of this phenomemon, and the waste of resources involved in the casual way that universities have tended to treat contract researchers, are, I suggest, two strong arguments for trying effectively to address the issue of academic careers for graduate scientists.

I welcome the attention being given to this important issue, and the opportunity to comment.

Ms S E Morrow
Science Planning Coordinator.

31 January 1995

Evidence from the Chemical Industries Association

The Sub-Committee has invited comments on seven specific questions covering various aspects of the enquiry. The question numbers given here correlate with those in the Sub-Committee's call for evidence. As the Sub-Committee has anticipated, we are not in a position to respond to every question and we have therefore been selective in our answers.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

   and

What are the advantages and disadvantages of the growth in short term research contracts in academic science?

This association, and The Royal Society, specifically identified the growth in short term contracts in science departments as a negative factor influencing the perceived status of academic scientists and engineers, in evidence to the government White Paper on Science, Engineering and Technology.[1] At that time we stated that *"there has been a sharp increase in the number of young academics who are on short term contracts in science departments. Figures for 1989–90 show that this category now constitutes approximately 42 per cent of academic staff in science departments; only a modest proportion of them can realistically expect a long term career in scientific research within the science base. This has resulted in a generally poor perception of science as a career, even by able scientists."*

Bearing this in mind, many young researchers have come to conclude that there are no real career structures available to them in academia, merely the prospect of a succession of relatively insecure contract positions. Such arrangements do not encourage high quality scientific research which is generally a long term endeavour. Many contracts are for one or two years, shorter than the time allowed for even a PhD thesis. We therefore fear that the excessive move towards short term contracts has had a doubly adverse effect on the academic research base: it has acted as a disincentive for good scientists to pursue an academic career, and it has compromised the ability of those that do to perform to the best of their ability.

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[1] Lock, S & Wells, F "Fraud and Misconduct in Medical Research', BMJ Publications: London, 1993.

5. *What should be done to improve the mobility of scientists between academia and industry?*

There is a close research collaboration which has always existed between chemical companies and academic research departments. As research and technological innovation becomes more important to the competitiveness of the chemical industry, this collaboration is likely to grow and, hopefully, so too will the mobility of researchers between the collaborating parties.

We believe that there are two major obstacles which have hindered the mobility of scientists between the sectors. The first is the disparity of remuneration for industrial and academic staff with the result that scientists have been encouraged to leave academia for industry, but not the reverse.

The second concerns the very different cultures in which academic and industrial researchers operate, and the differences in the motivation behind the research they carry out: *ie* the purely academic *vs* the wealth creating philosophies. Reconciling these differences is the central theme of the White Paper on Science, Engineering and Technology, which strongly promotes the concept of partnership between academia and industry, each playing to its strengths, with a good degree of effective collaboration at the interface.

Industry and academia must work to ensure that the second of the two obstacles we have described is overcome, through improved communication and mutual understanding. These efforts will be seriously compromised, however, if government fails to address the issue of academic salaries which, particularly for young researchers, remain extremely low.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

The association has conducted an annual survey of graduate recruitment for many years[2]. The survey includes information on the numbers of female recruits which have consistently accounted for approximately 40 per cent of the total recruitment. We have no reason to assume that there will be any significant change to the present situation over the coming decade.

The proportion of women in undergraduate chemistry departments is approximately 35 per cent (according to our latest figures from the Universities Statistical Record). This would suggest that the chemical industry is actually more successful at attracting women than men into a career within the sector. There does not, therefore, seem to be an issue to address concerning women at the level of graduate entry for the chemical industry. That is not to say that more could not be done to make scientific careers more attractive in industry, to men or women. Many of our member companies have recognised that career paths for scientists and engineers can be limited in comparison to their commercial counterparts. Some have taken steps to address this issue to good effect. However, more could, and should, be done to develop and nurture research talent, and to ensure that the contribution of scientists and engineers to corporate success is properly recognised.

7. *The government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of the scheme*

The position of CIA concerning the MRes degree has been outlined in our response to the government consultative document in April 1994[3]. We, along with a number of other interested parties, opposed a compulsory MRes prior to entry onto a PhD programme. We now know that this will not be the case and we are not opposed to the very limited MRes pilot scheme due later this year, since it is now only one of many options which remain available to students and higher education institutions. Of course, a true assessment of the worth of the scheme can only be made after the pilot exercise has been completed, and we would prefer to reserve further comment until then.

REFERENCES

1. Science & Technology—CIA Evidence for the Government White Paper (November 1992);

2. Graduate Recruitment Survey 1994;

3. A New Structure for Postgraduate Research Training Supported by the Research Councils—CIA Response to the Government Consultative Document (April 1994).

Dr P A Leonard

13 January 1995

Evidence from Dr L F Cohen, Imperial College of Science, Technology and Medicine

Summary

Although many academics will retire during the next decade this activity alone will not revive the atmosphere in the British academic environment nor provide incentive enough to keep many highly trained young scientists where they are needed most, contributing to the scientific wealth creation process. The Government must provide motivation for industry (possibly by tax relief or other financial compensation) to form stronger links with universities and similarly ensure that adequate funds are available so that medium to long term enabling science can be carried out within the university research structure. The MRes course may be the start of such academic-industrial human mobility links but it is important that the course is properly implemented. In particular that young people are trained in areas which have direct relevance for industrial needs. In order to attract more women into scientific careers, better child care facilities must be provided and an adequate system laid out for part time employment. Finally, to retain the interest of the young, academic science must be seen to have a more positive profile in the media and to be considered a profession which is financially rewarding to those who excel in it.

Since October 1993 I have been in the fortunate position of holding a Royal Society University Research fellowship in Physics at Imperial College. This fellowship will guarantee employment for five years in total. I am also one of a very rare breed of younger scientists who after three years post-doctoral employment in the States made a decision in 1991 to return to Britain to pursue an academic career. Furthermore, as a female physicist at Imperial College where there are only three permanently employed female lecturers in Physics and in a country where there are only two women Professors of Physics I think I am justified in saying that the position of women in the "hard sciences" and their ability to return to work after a career break needs to be examined more carefully. On this latter issue I wanted to bring to your attention the marvellous work being achieved on a shoe string budget by the Daphne Jackson Memorial Trust. I am not personally involved but am very much aware of their activities.

I am very pleased that there is recognition of the need for debate on issues related to academic careers for graduate scientists. I feel that the state of Science and Industry related career structures as a whole requires similar attention, also. Concerning the matters raised in the "call for evidence" I wish to contribute the following:

1. *Problems and Advantages of Current Career Structure for Academic Scientists*

The career structure for academic scientists in the hard sciences is in a very depressing state. The work load is enormous and the incentive minimal. Most scientists are performing three jobs—over-see their research activities, teaching and trying to obtain funds. We are being encouraged to form stronger links with industry but this is becoming increasingly more difficult as the UK industrial base, shrinks or focuses down on core business.

The job market is very limited and many highly trained people move abroad or out of their area of specialisation. I think that it is very discouraging for young graduates because the number of job opportunities in the "hard sciences" both in academia and in the industrial sector is small and in the former there is no pay incentive. I am in a fortunate position in the sense that I have a further three years employment by which time however, I will be too old to be hired or trained for most other kinds of work. My department have said that they would like to be able to offer me a position at some point in the future and on the strength of this insubstantial offer I am expected to take on various full time staff responsibilities. I am not in a position to refuse any task asked of me by my department althought they can not guarantee employment.

There is an overwhelming number of capable people who are unable to secure a permanent position. Most of these have been wholly or partially educated by the State for between six and eight years in order that they may carry out this type of work. When a post is advertised, although usually in a highly specialised area, there are somewhere between thirty to eighty responses, a handful of whom will be recommended by Nobel prize winners. This seems to me to be an incredible waste of human resource and training. No one can be expected to work on short term contacts indefinitely, the stress and uncertainty is intolerable and yet many do because they have no choice. It is no surprise to find that young people are not going into hard sciences any more.

2. *Short-Term Research Contracts*

Work performed by trained staff rather than carried out as an educational exercise by Ph.D. students is obviously more thoroughly, reliably and speedily accomplished. The benefit of experience is also the ability to identify the unusual and potentially interesting results as opposed to collating routine sets of data. Once people have developed these skills it is enormously beneficial to the research group activities to retain them for as long as possible. Eventually people on short term contracts become disenchanted, have no real work incentive, and no obvious future in the present scientific career structure.

3. *The Next Decade*

During the next decade there will be many academics retiring. However, not all of these posts will be renewed by the Universities because even if the percentage of young people who want a science based education remains constant, the baby boom years which resulted in massive expansion of academic positions are over. So in real terms, numbers will fall. Numbers will also fall because science as it is taught in school and university rarely manages to stimulate young people in the way they have come to anticipate from playing with computer game oriented technology.

Interestingly many of the people on "soft money" have been involved in a research environment for 10 or more years and are actually reluctant to take a lectureship and are not trained for it either. Most want to pursue a career in research.

4. *Destination of Scientists who have left contract Research*

Most scientists I know who have left contract research have gone into service industries such as Information Technology or Banking. Most have left because of the financial incentive even if they have moved to another area where there is little job security.

5. *Mobility Between Academia and Industry*

It seems obvious to me that there is a need for Government to create industrial incentive (by way of tax relief possibly), to create a new form of human mobility between academia and industry. It is important that long term research is pursued in this country if we are to retain our international standing. Most industrial environments can not afford to incorporate this into their research structure. The place for this work to be done is obviously in a well funded academic environment where academics have a realistic attitude towards enabling or strategic science. The industrial environment trains people to review a potential market and complete research targets in restricted time scales—this would be invaluable training for academic researchers also.

6. *Women in Science*

The situation with regards to women in science is improving slowly and this will increase as more female role models appear. Scientific careers for women would be more attractive if there were better ie more plentiful and inexpensive, child care facilities in this country in general and if it was considered more acceptable to carry out an academic profession on a part time basis. I think that many women would find a scientific career more attractive if it were more immediately relevant. This may be improved if there were stronger industrial—academic links.

7. *MRes qualifications*

In theory I am in support of the new Masters of research degree although it needs careful implementation. I think that some graduates are not ready for an industrial environment when they finish their degree course and yet a lecture based MSc does not tailor to their needs. The MRes courses should involve research areas which are of immediate or quite short term interest to industry, to ensure that holders of an MRes qualification will move over quickly into an industrial environment. Furthermore, I think that it must be followed through with Government linked industrial incentive. It may be necessary to survey areas of industrial requirement and make sure that they match quite closely to those proposed for MRes degrees. Finally, adequate funding must be provided at the university level so that the MRes research projects do not hinder the research group's main activities.

Evidence from the Commission of the European Communities, Directorate-General XII

GENERAL COMMENTS

Human resources in Science and Technology are, of course, a key factor for social and economic development. However, the lead times for their improvement are long and the costs involved are high.

According to the "European Report on Science and Technology Indicators (1994)"[1] a prime area for attention is the actual pool of research scientists and engineers, with the North American Free Trade Association (NAFTA) area having an estimated pool of over 1 million, significantly more than the 700,000 total for Western Europe, and 630,000 in Japan and the South East Asia region, where the rate of growth has been highest.

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[1] European Commission "The European Report on Science and Technology Indicators 1994", Luxembourg 1994, EUR 15897, ISBN 92-826-9004-0.

The proportion of research scientists and engineers in the business sector is lowest in Europe (52 per cent) compared to the US (75 per cent) and Japan (69 per cent). The indicators measured as a proportion of the labour force confirm the general pattern.

About 18,000 new doctorates in Science and Technology are awarded each year in the EU; this compares quite well with the EU's commercial partners in the world. Germany, France and the UK account for the largest number (4,500/5,000 each per year).

Although Europe possesses a great deal of human capital in the area of research, its utilisation is nevertheless often slowed down by the barriers which still tend to separate Member States and indeed scientific disciplines, thus at the same time hindering one of the most effective forms of technology transfer, namely, the "know-how" of experienced people. The development of human resources, by means of training through research, and then their better utilisation through mobility and transnational cooperation, are essential instruments for strengthening the knowledge-base of the European Union, the scientific and technological foundations of European industry and its international competitiveness.

The European Community's research activities stimulate the training and mobility of researchers in three ways:

- within each specific research programme under the research Framework Programmes, in order to provide, in priority areas, not only the needed research results but also the human resources capable of utilizing them;
- within a specific activity[2] addressing advanced training throughout the Community following a "bottom up" approach which is non-targeted and allows researchers wide scope to make their own research proposals, increasingly with the involvement of industry.
- Furthermore, the Fourth Framework Programme (1994–98) has initiated in the targeted socio-economic research programme, research into education and training in Europe and this should help to promote the introduction of innovations in training methods.

DESTINATIONS OF SCIENTISTS WHO HAVE LEFT EUROPEAN COMMUNITY RESEARCH PROGRAMMES

The research and technological development policy of the European Community, implemented by the successive Framework Programmes, has created the conditions for increasing the mutually beneficial interactions between research, training and mobility of researchers. A survey of the SCIENCE programme participants conducted by CREDOC (France) in 1990 showed that the objective of building networks had been well understood by participants. All forms of collaboration, including through the recruitment of new scientists, had been increased and that by a factor of three.

Based on a survey of 418 Community RTD training fellowships offered during the period 1966–88, a preliminary assessment of the impacts of the fellowship and subsequent careers of former fellows has been published by M Teichler of the Universität Kassel in 1990. 75 per cent of the fellows started their post-fellowship career as researchers and 30 per cent of them had moved towards more multi-disciplinary work. At the age of 45 or more, however, 30 per cent held management posts including in enterprises.

MOBILITY OF SCIENTISTS BETWEEN ACADEMIA AND INDUSTRY

A survey of the UK (1993) calculated that over 1,400 researchers participating in the first and second framework programme were registered for PhDs. Similar results were obtained in France with 2/3 of doctorates in the field of engineering going to industry six years later.

The gains in terms of increased competence and training found in sample of firms participating in 50 industrial and materials technologies research projects (BRITE/EURAM, 1993) has been estimated at 8 per cent of the overall "economic effects" and no less than 30 per cent of the indirect economic effects alone.

It is always difficult to quantify mobility even five years after the end of a programme. However, combining information arising from bibliometric analysis with that obtained from an enquiry amongst researchers who participated in programmes shows that enterprises do rely on external recruitment to acquire expertise in which they consider themselves deficient. According to data gathered during an independent evaluation of the European Community's Biotechnology Action Programme (1985–89), 20 per cent of researchers from public institutions who participated in that programme were employed five years later in industry.

Thus Community action in the area of biotechnology, where most research teams are involved in activities which are scientific in nature, has an important effect in stimulating the accumulation and diffusion of knowledge to industry. This research, which involves a variety of modes of cooperation (research consortia, industrial "platforms", laboratories without walls) between public and private participants. also shows itself to be a good training ground for those who will ultimately be employed in industry.

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[2] After an experimental phase, the STIMULATION plan (1985–88) 60 MECU was followed by the SCIENCE programme (1988–92) 167 MECU, the Human Capital and Mobility programme (1992–94) 581 MECU and now by the Training and Mobility programme (1994–98) 744 MECU.

A large effort has to be made to stimulate fully the mobility of researchers who, as producers of knowledge and know-how, are a critical variable in the transfer of technology between centres of research, universities and industry. The objectives of the current Fourth Framework Programme therefore include substantial emphasis on the promotion of training activities, individual fellowships and on support for access by researchers to large scale facilities.

THE SITUATION OF WOMEN IN SCIENCE AND TECHNOLOGY

The position of women is of particular interest, both because they represent an important potential for science and technology which has still to be adequately tapped, and because of the need to pay more attention to equal opportunities. According to IMS (Brighton) (1994), the graduation rate in science and technology for women is below that of men, by a factor 2 to 4, in the European Union. Looking back over the last decade, women's graduation rates have grown considerably faster, by 86 per cent in the case of Engineering and Technology compared to 26 per cent for men, showing that the trends are improving.

Participation in the Human Capital and Mobility programme (1992-94) reflects these discrepancies. Although only 30 per cent of the candidates for fellowships are women, their ability to succeed in the selection procedure is fully equivalent to that of men.

An analysis of participants in the EC's Biotechnology Action Programme (1985–89) has shown that males are only in a slight majority over females (by 56 per cent to 44 per cent). However, there was a marked tendency for the younger participants to be female. Subsequent careers show that women are more likely to be working in non-profit-making organisations and less likely to be academic, but there is no significant gender differences in the proportion of those employed in enterprises later on.

In 1993 an international workshop was organised by the European Commission on the issue: "Women in Scientific and Technological Research in the European Community". It was helpful in particular in identifying ways in which women's careers in science and technology could be given a stimulus and the obstacles removed. Within the Human Capital and Mobility programme, two networks of researchers have been set up to investigate "Gender and European Welfare Regimes" (coordinated by the London School of Economics) and "Female Labour Force Research Network" (coordinated by the University of Essex).

Moreover, the so-called fourth activity—Training and Mobility of Researchers—under the Fourth Framework Programme puts particular emphasis on ensuring equality of opportunity for both sexes.

Evidence from the Confederation of British Industry

The CBI welcomes the opportunity to provide evidence for the Select Committee's investigation into academic careers for graduate scientists. A strong science base is very important for the future competitiveness of UK industry, since it provides both highly educated individuals and the knowledge to underpin the development of new products and services.

Following consultation with a selection of CBI member companies, particularly the Inter-Company Academic Relations Group (ICARG), four of the seven questions were highlighted as being of interest to business. These questions affect the interaction of business and universities in a number of ways, including the calibre of individuals recruited to the science base.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

Following postdoctoral appointments in other academic's research groups, even excellent young scientists face a difficult step to establish their career and become successfully established members of staff. This step is limited by the number of vacancies available for lecturers. Perhaps therefore there is an argument for investigating whether there is room for an arrangement similar to that in the USA, whereby an aspiring lecturer is required to take up a "tenure-track" position. Effectively this is a two to three year probationary eriod, during which a young academic is given training where necessary and monitored as to his or her oficiency, while providing an opportunity to establish a research base. Although tenure for life has, quite devetly, been removed in the UK, a similar mechanism to the US approach could provide the step from short Acc research contract to academic career (indeed some universities are moving towards this), whilst attentioving skills for teaching undergraduates.

Associatiugh business can help support the core objectives of the universities through collaborative research total for Wt is often difficult to justify long-term investment—supporting PhD students over three years is been highesty different to funding a postdoctoral scientist over a similar timescale, although of course this does t business feels it should and does support universities where both sides benefit, the research

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[1] European Commuate scientists could be viewed as an infrastructural issue and consequently of more relevance ISBN 92-826-900ducation Funding Councils and Research Councils.

2. *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

Short term research contracts are often the key mechanism by which business collaborates with universities. However it must be emphasised that business recognises and values the longer term nature of research in the university system. Any changes which adversely affect the ability of universities to carry out this long term research would cause concern.

Perhaps the two main advantages of short term contracts are that it can provide flexibility in research and allow for mobility of scientists at an early stage in their career. The first point can be advantageous if a new research programme is developed, for example as a response to Technology Foresight. However the second can be a double edged sword since, although there is an advantage in experiencing research in different laboratories, this can inhibit the ability of young scientists to establish a research base in their own right.

The disadvantages of short-term contracts, particularly if they are less than 3 years, is that they can dissuade high quality graduate scientists from pursuing a career in the science base. In the case of one or two year contracts, it is often the case that scientists look for alternative funds or positions from the start of their contract. Such a distraction, not least including the preparation of proposals, can severely affect the actual amount of time spent on the research itself. This can lead to serious implications for the quality of research carried out under these conditions.

5. *What should be done to improve the mobility of scientists between academia and industry?*

The movement of scientists between the university environment and business should not only be welcomed but, where appropriate, actively encouraged. Such a movement in personnel is the most effective form of technology transfer.

Perhaps the biggest block to such mobility is still the cultural divide between academia and business. The generally well focused research occurring in business on a commercial basis can be in sharp contrast to the long term strategic research carried out in academia. The Teaching Company (TCS) and Senior Academics in Industry (SAIS) schemes are good examples of how such barriers can be broken down, bringing clear benefits to both partners. The TCS largely encourages the flow of scientists from academia to business, particularly giving the opportunity to small and medium size firms to have access to university expertise. In addition the scheme provides a base by which young graduate scientists can find a route into business. Mechanisms by which these types of scheme can be encouraged and made as flexible as possible should be considered. A simplified and flexible approach makes them more accessible for companies considering establishing links with a university for the first time.

Having said that the cultural divide may be responsible for the poor movement of business people into the academic environment, there are many examples of businesses actively participating in university departments which is helping to break this down. Such examples include sponsored chairs and lectureships, honorary posts held by business people, and financial support provided to "centres of excellence" or indeed sponsorship of new institutes.

The question of remuneration differentials appears at regular intervals, potentially accounting for a wish by high calibre individuals, to pursue a career outside the science base. In the past universities have operated a very rigid pay structure for both researchers, lecturers and indeed technicians providing laboratory support. There may be some argument for liberalising this rigid structure, allowing salaries to be negotiated more on a contract basis. The implications of such a decision would require further investigation. Whilst there may be the opportunity to attract and reward high calibre individuals, this may lead to trading down in other areas to "balance the books", thus exacerbating the situation. Any increases in salary of research staff should be aligned with performance of the individual rather than being automatic, so that those who perform above average are recognised.

7. *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

The CBI provided a response to the consultation process organised by the OST in 1994. No unanimous view emerged from our members over the proposed arrangements and there were clear sectoral differences. The pharmaceutical and biotechnology sectors, for example, do not envisage the MRes adding any value to the current arrangements. If companies in these sectors wish to recruit research scientists they value the skills and experience of PhD graduates. When asked as to whether they would recruit MRes graduates the answer was yes, but at the expense of graduates with only a first degree. Such qualified individuals would be paid an identical salary to those with a first degree.

Support for the MRes was largely centred on the engineering sector where some companies—but not all—supported the proposals. Consequently the CBI response promoted a flexible approach and urged that the MRes should not be a prerequisite to register for PhD. The CBI's consequent suggestion, was that if the MRes was to find a role, it would have to demonstrate that it did add value to the "products" (ie graduates) of postgraduate education. Such a judgement, or indeed any assessment of the output, will have to wait for an evaluation of the graduates from the proposed pilots.

The Engineering and Physical Sciences Research Council's (EPSRC) invitation to universities to submit proposals for pilot research masters courses stressed the importance of collaboration with industry. The CBI welcomes such an emphasis and hope that assessment will also take into consideration employers views. Indeed one possible role for the MRes could be to provide basic research training for individuals who subsequently wish to pursue a PhD whilst based in a business research environment.

In conclusion, business views the science base as a vital component ensuring the competitiveness of the UK. Companies seek provision of well trained scientists of high calibre as well as a strong long term strategic research base to which they can have access. Personnel within the science base are critical to these roles and as a consequence the attractions of a research career must be clear. The CBI hopes that barriers to mobility, and indeed collaboration, between business and academia continue to be reduced to the benefit of both parties.

Evidence from the Conference of Medical Royal Colleges

Question 1 and 2

We have been unable to identify any advantages of the current career structure and the growth in short-term research contracts. Short term funding, while appropriate for the needs of graduates in the early stages of their careers, for example in acquiring their research qualifications and exploring their vocations, become a powerful disincentive to continuing in research when family and other financial responsibilities have been accumulated. Moreover the anxiety associated with looking for the next job before the present one has been completed reduces the efficiency of scientists. There appears to be no more satisfactory system than a career progression into tenured posts for suitably talented and motivated scientists. Compared with wages in the business administrative sector, research salaries are not at a level compatible with periods of unemployment and job-searching. Short term funding is increasingly inappropriate for the longer-term collaborative work required for significant advances in many fields of contemporary science.

Question 3

At present the general view of the next decade, in the absence of remedial action, is somewhat gloomy. The government is not seen as having a serious appreciation of the necessarily long-term benefits of scientific research as distinct from industrial development. The reduced expansion in university funding in the last decade has led to a degree of stagnation with senior posts occupied by incumbents unwilling or unable to move on. One suggested remedy would be to fund posts for younger talented people now and recoup money by disestablishing more senior posts as they become vacant. Certainly the "new blood" posts provided a considerable stimulus to academic research activities a few years ago. Many academic clinical departments would benefit from the presence of a tenured non-medical scientist both in improving the health service provided and in developing new technologies. If universities were able to fund a pool of such posts they might be bid for on a competitive basis between departments.

Question 4

We are unable at short notice to provide systematic data on this question but it is generally recognised that some medical scientists opt for the security of NHS clinical posts rather than trying to continue on short term research contract funding. In the past this has represented a loss to the research community but we have hopes that the NHS R&D programme may make possible more part-time research by staff in clinical departments.

Question 5

We regret the lack of a trans-sectoral career structure that would enable graduates to transfer easily and without financial penalty between academic, industrial and public service sectors. It should be recognised that the ethos of scientific work in these sectors differs considerably and this also constrains the opportunities for migration between them. While the secrecy and subservience to business interests required of scientist in the industrial sector may be compensated to some degree by higher salaries, these are also a trap in that a return to academia or public service may be inhibited. There is a perception that the industrial sector is to some extent parasitic on the others in that they provide the training for the scientists that later serve industrial interests. This may be unjust but a more direct and systematic involvement of industry in training as well as career development for scientists might foster wider cooperation between industrial and academic sectors.

Question 6

There is a general feeling that women who wish to devote a period in their lives to child raising fare badly in the present system, but the solutions are not obvious. There is still disquiet about the quality of the teaching of science in schools in terms of interesting women in the subject.

Question 7

There is little enthusiasm for the government's MRes degree except as a means of signalling scientific literacy in people pursuing careers other than in scientific research. It is seen as being of little relevance to career scientists.

Some specific points

In the NHS the career structure for scientists, particularly in the pathology service. There should be statutory appointments committees for Grade C scientists and a more defined career structure for Grades A and B. The present trend towards deskilling of NHS pathology departments is having an important effect on recruitment to the pathology service and will in the long term inhibit research and development. This will have a particularly serious effect in the field of the molecular sciences. The present plans for provision for supraregional services are inadequate in many respects and this is also having a detrimental effect on the career prospects as viewed by scientists.

Evidence from Professor R A Cowley FRS, Chairman of Physics, University of Oxford

SUMMARY

There are problems in the growth of short term research contracts for both individuals and for large technologically advanced projects in Universities.

A limited number of semi-permanent posts are needed which do not carry the right to independent research but in which training is provided to enable new skills to be developed.

Industry should be encouraged to invest more in research.

The MRes is not applicable to Physics as the MPhys addresses many of the same problems in a more effective way.

A response to Call for Evidence for the Select Committee on Science and Technology, on behalf of the Physics Department at University of Oxford. The Department is large with 85 academic staff and 180 postdoctoral staff mostly employed on short term contracts.

1. THE PROBLEMS OF THE SHORT TERM CONTRACTS FOR ACADEMIC SCIENTISTS ARE:

(a) The loss of expertise as staff move on is particularly damaging for long term projects and facilities. Projects in particle physics, instruments in satellites, molecular beam epitaxy machines for semiconductors are typically projects lasting 10–15 years and having staff on three year contracts leads to a loss of expertise.

(b) Inevitably the academic staff on short term contracts must look after their immediate career prospects by publishing the maximum number of papers and concentrating on short term results rather than the long term development of the project.

(c) They often leave in mid-project for another post causing disruption to the project.

(d) They perceive their employment conditions as unfair compared with their peers in industry or the scientific civil service.

The advantages of the short term contract is that short term appointments for specific projects avoid the problems of redeploying and retraining staff at the end of a project.

In contrast the permanent contracts of academic staff possibly provide staff with too much security. Some security is obviously essential to preserve academic freedom and to enable staff to overcome misguided Heads of Department. Nevertheless, the right to do research in any topic provided funds can be raised is a very expensive right. Furthermore some people's careers change and it is currently difficult for University staff careers to evolve in different ways. More consideration needs to be given to how Universities can best use their staff in more flexible ways.

In general I consider that more scientific research posts are needed of indefinite period, but without the right to perform independent research. A necessary aspect of these posts would be the provision of training so that the holders could develop new skills as required, and so that the research programmes could develop.

In response to your other questions:

2. The DR Shift exercise has substantially increased the proportion of staff on short term contracts. As in United States Universities, this puts at risk the ability of Universities to carry through complex, lengthy projects of order 10–15 years duration. In the longer term this will be bad for UK science.

3. I doubt if there will be substantial changes as the number of short term posts is much larger than the number of academic staff likely to be needed. Correctly, many of those in short term posts will have to obtain posts in industry or finance.

4. The short term research staff leave Oxford for a wide variety of posts:

Academic posts in other universities
Posts in Government research laboratories
Posts in overseas universities and laboratories
Posts in industrial research
Posts in the financial sector
Posts in further education and school teaching.

5. One of the worrying features of the UK is the collapse of much of the industrial research in Physics based topics. The research laboratories at Phillips, GEC, BT, DRA, AEA etc have all been downsized. Consequently it has become more difficult to set up interactions. I suggest that more mobility would result from the Government arranging a financial structure so that it was more beneficial for industry to invest in research.

6. There are increasing numbers of women taking advanced degrees in science. The competition for permanent research posts puts a large emphasis on publication by age 35, which can be very disadvantageous to women, especially if they have a family. More secure posts would be of particular advantage to women.

7. The MRes proposals coincided with the development of the MPhys for physicists and has led to damaging uncertainty for the last few years. The decreasing content of formal Maths and Physics in the school syllabus means that our entrants are less well prepared than previously. One of the main aims of the four year MPhys course is to provide sufficient time for this to be rectified. It is also intended to incorporate some of the objectives of the MRes concerning projects and general skills training. We consider that these aspects are better and more efficiently taught as an integrated part of a degree course and so, for Physics, consider that the MRes should be largely abandoned. A dual system with both MRes and MPhys available will be inefficient, wasteful and confusing.

17 January 1995

Evidence from Dr Christine Davies, University of Glasgow

I gather that you are collecting evidence for a House of Lords Sub-Committee enquiring into Academic Careers for Graduate Scientists. I would like to make a few points on the problems of career security and how that affects women scientists in particular. These are based on my own experience as a theoretical physicist and that of various colleagues.

Postdoctoral positions in theoretical physics are typically of two years duration and run from October to October. Postdocs arrive at an Institution in one October and must apply for the next position in the Autumn of the following year. Thus it is very hard to imagine taking time out to have a family and still be able to compete. In any case, to take maternity leave, you generally need to have worked at that Institution for a certain length of time (1-2 years), although this requirement has been reduced in recent years. I was lucky to get a long-term position (SERC Advanced Fellowship) at a relatively early age (26) so that I had time to have a family and still catch up.

Permanent positions are rarely given in theoretical physics to people under the age of 30, and often people are much older (I was 34 when I became a lecturer). This again causes problems for women who want to have families. This is quite apart from the difficulty for women of obtaining a permanent position if they are tied to the location of their husband's job (and woe betide them if their husband is already an academic at the same institution!).

I believe there needs to be more provision for longer term postdoctoral positions (perhaps at the cost of some short-term positions). Also salary should be explicitly related to experience and not to age (as it currently is). Too often the money is not available to hire a women who (perhaps because she has had a family) is older than a man with equivalent experience.

I hope your Sub-Committee will feel able to make useful recommendations on these points.

Evidence from the Department of Health

1. BACKGROUND

1.1 Graduates of both life sciences and physical sciences employed in NHS Trust hospitals, Special Health Authorities and in the Department of Health's Non-Departmental Public Bodies are unable to follow a range of career paths.

1.2 Science graduates employed as Clinical Scientists have access to an academic career path that is somewhat different to that followed within a teaching or research department in a university. Members of this professional group not only carry out service work associated with healthcare delivery but also conduct publishable research, teach scientific and other staff at undergraduate and postgraduate levels and may hold honorary or part-time appointments in associated medical schools, universities and other academic institutions.

1.3 Training as a Clinical Scientist equips an individual for many careers, including several outside science itself. The acquisition of planning skills, the ability to think logically, implementation skills, critical appraisal and evaluation of data and report writing are in demand in many sectors of society, including most management posts.

1.4 Clinical Scientists have a right to expect that their training will be utilised and recognised. Most do not join the profession with the intention of leaving it. Hence an overall manpower policy is needed that firmly links the number of training commissions with the predicted number of career posts available. This is difficult to achieve for small professional groups like Clinical Scientists.

1.5 A detailed description of Clinical Scientists, their functions, training and career structure is given at Annex A (*not printed*). The answers to the questions posed by the Sub-Committee relate mainly to this small professional group.

2. QUESTIONS

2.1 *What are the problems and advantages of the current career structures for academic scientists in the UK?*

Problems

- The role of Clinical Scientists in the NHS is poorly understood.
- NHS Trust hospitals offering a purely routine service function may have no clear need to employ Clinical Scientists. There are concerns that the downward pressure on healthcare costs will further reduce the funding available for service development research and that the number of Clinical Scientists employed in the NHS may drop as a result. This profession could then become highly vulnerable due to the loss of a self-sustaining critical mass.
- Because of the small numbers of Clinical Scientists required within NHS and Department of Health facilities there are considerable difficulties in matching supply with demand. The training period and the level of specialised training needed for Clinical Scientists is similar to that received by clinicians. However, there is no equivalent defined funding available to cover training for higher professional qualifications or to undertake continuing professional development.
- Career progression through the main professional grade is largely by the acquisition of increased management or service responsibilities and not on research merit. As a consequence, some of the more gifted Clinical Scientists move to better paid or more challenging posts in other sectors and so are lost to the profession.
- The training needed to provide specialised clinical services restricts the movement of scientists from the commercial and university sectors into the Clinical Science disciplines.

Advantages

- Clinical Scientists have a better career structure than university scientists. They also have the satisfaction of mixing a rewarding career in the delivery of healthcare with an exciting career in research.
- Clinical Scientists work at the interface between basic science and its application to "real" problems. They represent a model for the future in which research scientists become better able to apply their skills and knowledge by having direct experience of the communities which they serve.

2.2 *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

All Grade A Clinical Scientists are employed on short, fixed-term (usually two to three years) contracts. Over the past few years employers have begun to give short-term contracts to Grade B Clinical Scientists at the more junior levels.

Advantages

- This system provides employers with the flexibility to respond to changing research and development needs. It was introduced to prevent grading drift, to promote job mobility and to facilitate the exchange of staff with other sectors.
- Short-term contracts enable individual scientists to obtain a varied set of experiences and this opens up their work to peer review on a regular basis.

Disadvantages

- The supply of short-term contracts does not always match the availability of potential or qualified Clinical Scientists looking for jobs.
- For Grade A Associate Clinical Scientists the contracts available are not always of sufficient duration to allow a higher degree to be obtained.
- Scientists that undertake a series of short-term contracts are often perceived as having no real career history and may therefore find it difficult to obtain more senior positions.
- Short-term contracts generally prevent individual scientists from acquiring research grants in their own name so preventing them gaining valuable experience in research management and a professional reputation with their peers.
- Employment on short-term contracts makes Clinical Scientists subject to market forces and this prevents them from developing a personal long-term career strategy.
- Vacancies have not occurred in sufficient numbers to promote the anticipated level of staff movement within the main professional grade.

2.3 *How do you expect the situation to change in the next decade?*

- It is likely that the restructuring of the NHS will reduce the funding available for implicit research and hence the number of permanent Clinical Scientist posts available is likely to fall.
- The introduction of multi-disciplinary working may also contribute to reductions in the number of Clinical Scientist posts available. Clinical Scientists should respond to this challenge by taking the opportunity to diversify and so further improve the quality of staff available for the future delivery of healthcare.
- As student loans become more prevalent there will be increased pressure to obtain full-time permanent employment, or at least the prospect of this long-term, immediately after graduation. The Clinical Scientist career structure offers this possibility and hence greater competition for the few training placements or permanent jobs available is likely to increase. The current disinterest in science in schools may balance this by causing fewer scientists to be available to enter the career in the first place.

2.4 *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

No firm information is available on this question. The perception is that Clinical Scientists do not have any favoured destination if they leave this career but depend on market forces and posts available at the time. As indicated previously, a training in clinical science enables individuals to consider a broad range of alternative career options.

2.5 *What can be done to improve the mobility of scientists between academia and industry?*

It is important to recognise that, although Clinical Scientists are part of the academic community, the NHS itself is an industry in its own right. Close links already exist between universities and the NHS. These links can be used to engender realism and applicability in the research projects done purely within the university departments and they give NHS scientists greater access to both research facilities and funds.

Free movement of scientific staff into the NHS from either the commercial sector or the universities to fulfil the full range of responsibilities currently done by Clinical Scientists is generally prevented because of the specialised training needed by this professional group. Exchange of research staff and joint funding of posts sometimes occurs. Improved mobility of scientists between the NHS research base and the commercial sector can be achieved by:

- Increasing the number of communication networks between the two sectors so that the flow of information, ideas and opportunities for technology transfers are all improved.
- Providing additional resources to finance fellowships and other secondments in both directions.
- Increasing the funding available to programmes such as LINK, the Teaching Company Scheme and the Post-Graduate Partnership Scheme and ensuring that NHS staff can compete for these funds on a level playing field with their university colleagues.
- Recognising the value, relevance and importance of industrial experience in the career history of a Clinical Scientist.

2.6 *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

Much has been done to improve the opportunties available to women employed in the NHS and there already is a high proportion of women within the clinical science specialties. They are, however, currently under-represented at the highest grades. Promoting Clinical Scientists as being members of a caring profession may further increase the number of women entering this career.

The Whitley Councils are committed to the principles of equal opportunities. They have agreed that employers and employees should work together to develop and practice positively the concept of equal opportunities for all during the application of their agreements and in operating recruitment, training and promotion policies. They recognise the contribution which can be made by flexible working arrangements such as part-time working, job sharing and flexi-time working. Implementation of these principles will clearly help to make Clinical Science more attractive to women.

The Councils have emphasised the importance of health authorities addressing the particular needs of staff who wish to make provision for their young children to be cared for while remaining at work. The Councils commend the establishment of an appropriate range of facilities to assist with child care. Access to improved childcare facilities will be of considerable benefit to women in Clinical Science.

An enabling agreement on retainer schemes has been reached. This has been designed to give employers the scope to establish effective arrangements for securing, retaining and encouraging skilled staff back to work. Employers are free to make whatever arrangements they wish for continuing and/or refresher training and other measures which they think will assist skilled and experienced staff to return to work. Positive encouragement and recognition of any continued professional education or development undertaken by women during a career break will be beneficial and may help to ensure that they are not disadvantaged when competing for posts on their return to work.

The Councils have recommended to all employers that they establish, in consultation with staff and their representatives, job sharing schemes to provide more flexible working arrangements.

The General Whitley Council has also agreed the framework within which employers can make arrangements for special leave to allow staff to balance the demands of domestic and work responsibilities at times of urgent and unforeseen need.

All of this provides the best possible foundation on which NHS Trusts can build working arrangements designed to meet the needs of their staff, and in this specific case female Clinical Scientists, within the overall needs of service provision.

On a more general note, science should be made fun, exciting and challenging at school for all pupils regardless of gender. This requires a motivated and skilled teaching profession. It also needs more scientists, such as Clinical Scientists, going out into the community and talking with school children to demonstrate the uses, rewards and social benefits associated with their chosen profession.

2.7 *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

A PhD is granted in recognition of a person's proven ability to design, complete and defend a sustained investigation that increases, rather than merely reorganises, the sum of human knowledge. There are two main problems with the current way in which the PhD degree is organised.

First, some students with a high quality first degree prove to be either unsuitable or not motivated for the discipline of research. This implies that better criteria are needed to select prospective PhD students. Several universities insist that students are registered for an MPhil, or equivalent, in the first instance and only transfer them to a PhD once they have demonstrated their abilities and commitment.

Second, the PhD degree involves training in both research techinques and in a specialised subject area. Three years is a reasonable time to acquire the training for this specific purpose and it should not be forgotten that UK research workers are highly regarded by the scientific community in the rest of the world. However, there is some concern that this training is too narrow and inadequate for future employment outside of a purely academic environment.

To some extent these two problems are addressed if a student first does an MSc. This degree will provide training that is subject specific and, providing the degree is genuinely designed to train scientists as opposed to specialist technicians, will incorporate a substantial research aptitude in this area. An MSc therefore broadens a student's knowledge base and can be used to provide an effective screen for further research training.

The value of using a MSc as the first part of specialist training for Clinical Scientists is already well recognised and supported by the Health Departments. Clinical Scientists are then encouraged to progress either directly to a PhD programme (if a research degree is not already possessed) or to training for membership of one of the professional bodies. This subsequent training is usually undertaken on a part-time basis.

It is not clear what a Master of Research degree will provide in addition to what is already available. It is also not clear how this degree will lead to the production of better research workers or, indeed, workers better able to fulfil careers outside academia or in industrial laboratories.

The proposed MRes appears to provide training in, but not practical experience of, research methodology, very little of which is subject specific. This assumes that there is a specific component of research which needs to be taught or can be taught, rather than learnt experimentally. The MRes therefore by itself indicates neither competence in research methodologies, nor the acquisition of further additional specialised knowledge, nor the motivation to undertake an in-depth programme of research.

Increasing the length of a PhD programme to four years by using the proposed MRes degree as a screening procedure is not desirable. The value of the qualification could be easily undermined particularly if it became regarded as a failed PhD. The latter, in concept, is no bad thing; if quality is to be maintained then failure has to be expected but a certificate of failure is not appropriate.

If the overall period assigned for producing well qualified and competent research workers was to be extended then one of two other options would be preferred. The first is to make more extensive use of the existing MSc system. The second is to extend the length of the undergraduate degree course to accommodate the falling standards in the general education of students entering university and to provide a broader range of vocational skills and work experience.

January 1995

Evidence from the Department of Trade and Industry

1. The Committee will have noted the evidence submitted by the Office of Science and Technology which mentions at paragraph 31 (with reference to question 5) a number of initiatives which have been introduced by Government to promote mobility between academia and industry. The purpose of this memorandum is to provide the Committee with additional information about those initiatives for which the Department of Trade and Industry has specific responsibility.

Summary

2. Chapter 7 of the 1994 Competitiveness White Paper (Cm 2563) sets out DTI's main policy imperatives in the field of Innovation. Improving the ways that business can access and apply technologies developed in the academic sector is an important means of both raising the competitiveness of UK firms and improving the value for money from the investment in the original research. DTI manages a number of schemes which seek to achieve these objectives by encouraging mobility between academia and industry. These schemes also provide stimuli for academics to feed back into their mainstream activities.

3. Over and above the formal schemes described in this Memorandum, DTI encourages firms to sponsor HEI-based R&D, to take an interest in curriculum development and to be constructive in building relationships with individual HEIs so that graduates gain a realistic impression of the nature of technologically-based business.

4. With the exception of TCS, most of the schemes are relatively new; DTI believes that a period of consolidation is required so that the academic and industrial communities can understand how best to use the opportunities that these schemes present.

5. The Committee may wish to be aware that the NAO is presently conducting a value for money study on DTI's support for innovation. The results may become available during the course of the Committee's proceedings.

TCS (the Teaching Company Scheme)

6. TCS (the Teaching Company Scheme) was introduced by the then Department of Industry and the Science Research Council in 1975 in order to provide high quality company-based post-graduate training for engineers akin to that received by doctors in teaching hospitals.

7. In the intervening period the scheme has evolved to focus more closely on technology transfer rather than training *per se*. The scheme offers high quality graduates the opportunity of spending two years in a firm implanting a particular technological process which will be of significance in improving the competitiveness of the firm. In so doing the graduates (termed TCS Associates) obtain valuable experience of the workings of industry as well as making a positive personal contribution to the firm. The Associates are jointly supervised by a University member of staff and a manager from the host firm. About half the Associates register for a higher degree (usually at Masters level), but TCS is not primarily designed as a post-graduate degree programme.

8. TCS is widely acknowledged as being one of the most effective mechanisms available for improving academic—industry mobility and has been replicated in several overseas countries.

9. TCS currently involves 87 Higher Educational Institutions (HEIs) and nearly 300 individual departments. Nearly 500 firms are involved, over half of them being small and medium sized enterprises (SMEs) with fewer than 250 employees; there is a wide mix of sectoral involvement.

10. The scheme is sponsored by six Government Departments and three Research Councils. Efforts are being made to extend the sponsorship even further. Currently, 514 individual TCS programmes are in progress involving nearly 1,000 TCS Associates.

11. Research Councils tend to view TCS as a natural follow-on mechanism for transferring applicable outputs of their sponsored basic research programmes into industry. Means of formalising the contact between LINK Programmes and TCS are being put in place to provide a continuum for the uptake of LINK project work. Concepts identified in the Technology Foresight Programme will be considered for adoption as TCS Programmes in due course.

12. Government Departments tend to view TCS more broadly; it has scope to offer a general route for technology transfer from academia to industry, irrespective of the provenance of the research.

13. The activities of individual academics can benefit from the contact and feedback with industry that arises through supervision of TCS programmes. They are able to offer more relevant, higher quality teaching and relate their research to realistic industrial problems. This aspect of the effects of TCS on universities is currently being investigated by the Science Policy Research Unit (SPRU) of Sussex University. (SPRU have previously surveyed the impact of TCS on host firms).

14. DTI is supporting the establishment of up to 20 "TCS Centres" located in specific HEIs. The purpose of such Centres is to offer a point of contact for local SMEs and to raise the scheme's profile. The Centre manager will have oversight of all TCS programmes run by that university. TCS Centres will form a natural point of contact with Business Links and similar bodies in Scotland and Wales.

The Senior Academics in Industry Scheme

15. The Senior Academics in Industry Scheme (SAIS) commenced in 1993 as an initiative to encourage those academics without recent close involvement with industry to take a secondment of about 6 months in industry. This would enable them to apply their academic knowledge in an industrial context and also develop an understanding of industrial processes and priorities which could be applied in their own teaching and research. The Scheme has not been used as widely as was thought possible: it has not appealed to those in "pure science" who perceive their research to have limited industrial relevance, whereas in industrially relevant disciplines many academics already work with industry and have achieved the experience that SAIS provides. By the end of the 2.5 year pilot phase of the scheme (later this year) there will have been about 20 placements. The academic participants and their host companies have found the scheme to be extremely beneficial, but its limited scale makes its continuation questionable.

Postgraduate Training Partnerships

16. Postgraduate Training Partnerships (PTPs) were introduced in 1992 as part of the Government's response to the recommendations of the Prince of Wales's Working Group on Innovation. The aim of the scheme is to provide a number of industrially relevant PhD training places which are located in specific partnerships established between university Departments and Research and Technology Organisations. The style of the PhD is distinctive, embodying taught elements relating to research management and best practice together with a project which has been selected as particularly relevant to the industrial community served by the RTO in question.

17. Five partnerships were established in 1992 following a competitive call for proposals. Each partnership has taken 10 students per year for the past three years, hence there are presently 150 PhD students involved in the scheme. Thus far, the scheme has been recognised by commentators as a success. It brings universities, RTOs and firms closer together and refreshes their respective research and technology bases.

18. The formal PTP scheme is jointly administered by DTI and EPSRC. Proposals for its extension are presently under consideration. Three smaller programmes, involving other RTOs and universities (not sponsored by DTI/EPSRC) have also developed in the meantime. We welcome this development as an indication that this is a mechanism which both the universities and Research and Technology Organisations find useful.

Other support

19. DTI has supported the Royal Academy of Engineering's Visiting Professorships in Engineering Design since 1992. The net effect of this support is to add about 15 professorships to the total supported by other sponsors. The Department welcomes the opportunity of appointing these senior industrialists in a role where they are able to enthuse and influence high quality students to take up careers in engineering.

20. The Department also supports the Shell Technology Enterprise Programme (STEP) run by Shell UK Ltd which encourages second year undergraduates to take an eight week summer placement in a small firm

in order to address a particular technological problem that the firm has encountered. The Department's support for this scheme has resulted in a rise in the number of placements offered each summer to over 1,000. Around 90 per cent of host firms said that the STEP placement would have a long-term impact on the business, particularly in terms of culture, technological awareness and the need for up-skilling.

Future activities

21. The 1994 White Paper on Competitiveness (Cm 2563) mentioned at paragraph 7.30 that the Government will consider options for a scheme similar to TCS to promote the transfer of people between further education institutions and local companies. DTI is currently investigating the potential for such a scheme aimed at people with an NVQ level 4 qualification (or equivalent). The objective would be to encourage such individuals to take a placement in a local firm for nine months to one year. They would work under the supervision of a local college in order to transfer into the firm a particular technological process in which the college had expertise. DTI will shortly be issuing a consultation paper to those likely to be interested in this activity.

Wider issues

22. As part of the policy changes set out in the 1993 White Paper "Realising Our Potential" and the 1994 Competitiveness White Paper, DTI is seeking to develop further mechanisms to encourage the greater mobility of people between academia and industry. Although yet at an early stage, the thrust of these proposals will be towards implementing a change in the cultural attitude towards placements and secondments in organisations other than that where an individual is permanently employed.

31 January 1995

Evidence from the Gender and Science, Engineering & Technology (SET) Project

Executive Summary

The Gender and SET project is based at the Department of Sociology of the University of Surrey and is funded by the Economic and Social Research Council and Roehampton Institute London for a two-year period (1994–96). Using secondary analysis of cross-sectional and longitudinal data sets, primarily the Labour Force Survey and the National Child Development Study, the project seeks to explore a range of issues surrounding the first and subsequent occupations of women and men with SET qualifications.

This memorandum presents analyses showing the growth of women's representation both as SET graduates and in SET occupations. It also examines the degree of correspondence between SET qualifications and occupations and assesses whether this is different for women and men. Our analyses indicate that SET-qualified women and men experience the SET labour force in different ways. Women are more likely to be inactive and, if they are in the active labour force, to show less correspondence between SET qualifications and SET occupations than is apparent for men. For women this correspondence is least strong if they are technology graduates; it is strongest if they have an engineering degree. Men with Mathematics and Computing Science degrees are more likely to be in SET occupations than their female counterparts.

Our conclusion is that it is one thing to bring about an increase in girls' and young women's SET qualifications, but that it is quite another to ensure that such an increase is reflected in SET occupations.

Acknowledgements

We could like to thank OPCS for allowing the use of the Labour Force Survey 1994, the ESRC Data Archive at the University of Essex for supplying the data sets and the Manchester Computing Centre for facilitating access. This work was carried out under ESRC Research Grant No R000 23 5507 and Roehampton Institute London Research Grant No R640H.

1. *The Gender and Science, Engineering & Technology (SET) project*

The Gender and SET project is based at the Department of Sociology of the University of Surrey and is funded by the Economic and Social Research Council and Roehampton Institute London for a two-year period (1994–96). Using secondary analysis of cross-sectional and longitudinal data sets, primarily the Labour Force Survey and the National Child Development Study, the project seeks to explore a range of issues surrounding the first and subsequent occupations of women and men with SET qualifications. These issues include an examination of age-related "gender tracks" in SET occupations; an exploration of gender differentiation in different sorts of science and engineering occupations; a comparison of women's and men's income in SET occupations. It is a cross-national project, comparing France and Britain.

2. *Aims of this memorandum*

We set the scene in the memorandum by presenting analyses showing the growth of women's representation both as SET graduates and in SET occupations. We then present some analyses of the relationship between SET qualifications and SET occupations. The aims of the analyses are to examine the degree of correspondence between qualifications and occupations and to examine whether this is different for women and men. From one point of view, a weak correspondence between the two could be seen as a waste of qualifications. We do not necessarily endorse this view; for example, it is questionable whether a SET degree which leads to a teaching career is a waste of that degree. However, if such a pattern was more prevalent amongst women with SET qualifications than amongst their male counterparts, then this would be a concern of the project. Gender issues are the central issue; the "manpower planning" issue of whether a particular degree should or should not lead to a particular occupation is not our immediate concern here.

3. *Data*

The analyses presented here use only cross-sectional data. In a later stage of the project, we will move onto longitudinal data, since cross-sectional data do not allow for a distinction to be made between the effects of age/generation and those of particular cohorts. We are in the preliminary stages of our project; cross-sectional data are appropriate in terms of setting the scene, but provide an incomplete—and sometimes misleading—answer when the "time" variable is introduced into the analyses. Where we judge that our use of cross-sectional data is leading to an erroneous conclusion, we have made an appropriate caveat in the text.

Our analyses use secondary analysis of the Labour Force Survey 1994, Quarter 1. The Labour Force Survey is a sample survey carried out by OPCS on behalf of the Employment Department. It provides a nationally representative sample of around 60,000 households each quarter and has a response rate of around 90 per cent. Between 1984 and 1991, the Labour Force survey was carried out annually. From 1992 onwards, it has been carried out quarterly, with the same sample size each quarter as the previous annual survey (OPCS, 1993). We also make use of published statistics from the Universities' Statistical Records (Universities' Statistical Records, 1993 & 1983).

4. *Definitions*

We refer to *SET qualifications*, the *SET labour force* and *SET occupations*. These terms are defined below.

4.1 *SET qualifications*

We are concerned only with degree-level qualifications in our study. SET degrees can be broken down into four constituent groups: science, engineering, technology, mathematics & computer science. Science degrees are: Biology, Botany, Zoology, Genetics, Biochemistry, Food Science, Chemistry, Physics, Astronomy, Geology and Geography (as Physical Science). Engineering degrees are: general, civil, mechanical, aeronautical, electrical, electronic, production and chemical. Technology degrees are: metallurgy, minerals technology, other materials technology, maritime technology and biotechnology. We have also included Mathematics and Computer Studies, combined into one category in Table 3.

4.2 *The SET labour force*

We define the SET labour force as people with SET degree-level qualifications (see 4.1. above) who are in employment (whether SET or non-SET), unemployed (ILO definition: seeking work and available for work) or inactive (not seeking employment).

4.3 *SET occupations*

In common with other government data sets, the Labour Force Survey uses the Standard Occupational Classification (OPCS, 1990). SET occupations comprise: biological scientists, biochemists, chemical scientists, physical and geological scientists, mathematicians, other natural scientists, engineers (civil, structural, municipal, mining, quarrying, mechanical, aeronautical, mechanical development and design, electrical, electronic, software, chemical, production, planning and quality control, other engineers), metallurgists, other technologists, computer analysts/ programmers.

5. *Women: a growing presence in SET*

Women are increasingly represented amongst SET graduates (Table 1).

Table 1: Women as a proportion of SET graduates, two time-points

Degree subject	*1980–81*	*1991–92*
Engineering & Technology	6 per cent	14 per cent
Physical Sciences	19 per cent	30 per cent
Biological Sciences	49 per cent	58 per cent

Source: Universities' Statistical Record 1983 and 1993

Table 1 indicates that the primary increase in women's SET representation between 1980–81 and 1991–92 is in Engineering & Technology. There is some increase in Physical Sciences and rather less in Biological Sciences, an area where women have traditionally been well represented. When engineering graduates are examined separately, women's representation has increased from seven per cent in 1984 to 15 per cent in the early 1990s (Engineering Council, 1993).

In the next section, we examine women's presence in the SET labour force within the 21–30 age group. We are using here the concept of a *potential labour force*, those people with a SET degree-level qualification who are either in or out of employment.

6. *Characteristics of the SET labour force*

Table 2 shows four different employment statuses for women and men SET graduates. These statuses are: (i) in SET occupations, (ii) in non-SET occupations, (iii) unemployed (using the ILO definition: both seeking paid work and being available for it) and (iv) inactive (not seeking paid work).

Table 2: Occupational status of SET graduates aged 21-30

Employment status	*Women*	*Men*	*Total*
In SET occupations	21 per cent	36 per cent	32 per cent (295)
In non-SET occupations	60 per cent	49 per cent	53 per cent (488)
ILO unemployed	5 per cent	6 per cent	6 per cent (52)
Inactive	14 per cent	9 per cent	10 per cent (94)
All	100 per cent (280)	100 per cent (649)	101 per cent (929)

Source: Quarterly Labour Force Survey 1994, Spring Quarter, authors' analyses

Note: Column percentages do not total to exactly 100 per cent because of rounding to whole numbers

Table 2 shows that, within the age range 21-30 years, only 21 per cent of women with SET graduate level qualifications are in SET occupations, compared to 36 per cent for their male counterparts. This therefore indicates that, compared with men, there is less correspondence for women between SET qualifications and SET occupations. For both women and men, but particularly for women, the proportion in non-SET occupations is perhaps surprisingly high (60 per cent for women, 49 per cent for men).

Analyses of older age groups (not shown here) indicate that, as age increases, so do the proportions in non-SET occupations. This is the case for both women and men, although more particularly for women. For example, amongst SET graduates aged 41-65 years, 75 per cent of the women are in non-SET occupations, compared to 61 per cent of the men. There are likely to be different explanations of this for men and women. For men, a non-SET occupation may be a managerial occupation, albeit in a SET environment; for women, it is more likely to be a non-SET occupation outside a SET environment. We intend to carry out further exploration of this issue.

Up to this point, we have used the generic term "SET". In the following section, we look at the distinctions between science, engineering and technology degrees in order to examine in closer detail the degree of correspondence between SET qualifications and SET occupations. We have also included a combined mathematics and computer science group.

7. *Making a distinction between science, engineering and technology qualifications*

The relationship between SET qualifications and SET occupations varies according to the degree subject (Table 3).

Table 3: SET degree subject and SET/non-SET occupations, by sex, age 21-65

(a) Women

Occupation	*Degree Subject*				*Total per cent*
	Sc	*Eng*	*Tech*	*Maths & Comp Sc*	
	per cent	*per cent*	*per cent*	*per cent*	
SET	18	41	16	26	21 (118)
non-SET	82	59	84	74	79 (459)
All	100 (359)	100 (32)	100 (61)	100 (125)	100 577

(b) Men

Occupation	*Degree Subject*				*Total per cent*
	Sc	*Eng*	*Tech*	*Maths & Comp Sc*	
	per cent	*per cent*	*per cent*	*per cent*	
SET	27	44	20	38	33 (728)
non-SET	73	56	80	62	67 (1,462)
All	100 (699)	100 (790)	100 (389)	100 (312)	100 2,190

Source: Labour Force Survey 1994, Quarter, authors' analyses

Table 3 shows that, for women, there is a higher degree of correspondence between having an engineering degree and being in a SET occupation than in the other degree subjects. It is also noteworthy that, for men, having a mathematics/computing science degree is more likely to lead to a SET occupation than for women (38 per cent and 26 per cent respectively). Further analyses (not shown here) indicate that teaching is a common outcome for women with mathematics/computing science degrees, but at below Higher Education level. When men with SET degrees go into teaching, there is a tendency for them to teach at Higher Education level.

8. *Conclusion*

Over the past decade or so, government-sponsored effort has been put into encouraging girls to become SET-qualified. There is some evidence of a growth in the proportion of women who are SET graduates, although it would be hard to establish any causal relationship between initiatives and growth.

Our analyses indicate that SET-qualified women and men experience the SET labour force in different ways. Women are more likely to be inactive and less likely to be in SET occupations than their male counterparts. Furthermore, there is less correspondence between SET qualifications and SET occupations for women than for men. For women this correspondence is least strong if they are technology graduates; it is strongest if they have an engineering degree.

Our final comment is that it is one thing to encourage girls and young women to gain SET qualifications; it is quite another to ensure that any increase is reflected in the occupational structure and that it is accompanied by equality of outcome and income. Unless attention is paid to the aspects inhibiting women's progress within SET *occupations* (see Carter & Kirkup, 1990; Devine, 1992; Evetts, 1994), any growth in girls' and young women's SET qualifications may lead to frustration on the part of women. From the government's point of view, a considerable "mismatch" between qualifications and occupational outcomes is of course also a loss of valuable and expensively trained talent.

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23 April 1995

Evidence from Dr D Grant, Director of Technology, General Electric Company plc

I refer to your letter of 16 December to Mr Porter, Company Secretary to the GEC.

After reviewing the call for evidence, and discussing it with colleagues in our research centres, I believe we are not able to make any helpful comments from a company perspective.

There is one personal comment, however, based upon experience in my role as Chairman of a panel of the OST's Technology Foresight Programme. Your question 5 touches upon the mobility of scientists between academia and industry. My panel for the Foresight Programme has 12 academics and 12 industrialists, and one particularly relevant issue we have discussed is the question of reward and recognition (non-financial) for the work of a researcher. There is a problem for academics who work with industry, caused by the HEFC's Research Assessment criteria. In essence, a researcher and the department of his or her university often gain no recognition for helping industry and would rather spend their time producing papers for learned journals. These papers are judged to be of higher importance to many individuals and departments than working with industry.

This matter is being addressed elsewhere, but it may well influence the mobility of scientists between academia and industry.

16 January 1995

Evidence from Glaxo

SUMMARY

Introduction

1. Companies such as Glaxo must be in a position to maintain the excellence of their scientific and technological research and development activities if they are to continue to be successful. We must be capable of exploiting the explosion in new knowledge, made possible by developments within the fields of molecular and cellular biology to understand disease mechanisms and identify new therapeutic targets for the discovery of novel medicines to cure and prevent disease.

2. Well-trained and skilled people are the most important assets that pharmaceutical companies have, particularly those scientists and technologists who are involved in harnessing scientific developments for the discovery and development of new medicines. The strength of the pharmaceutical industry in the UK is largely due to the fact that British universities have been able to produce such people to meet our needs.

3. There have been signs over the last ten years that the UK has been slow to react to the changing scientific climate, and has, as a result, lost the initiative in areas such as molecular biology and genetics. There is also now concern that the quality of science graduates emerging from many of our universities is declining. There is also a dearth of trained technicians for our laboratories.

4. The UK is competing, both academically and industrially, in an international environment and must be prepared to bring about the changes necessary to meet new challenges. Thus the provision of a skilled, imaginative and energetic science and technology community must be a matter of high priority.

Glaxo's need for Scientists and Technologists

5. Glaxo has three broad needs to be met by academia:

(a) **Graduate scientists and technologists** capable of working in the research laboratory or parascientific environments (eg in Robotocs, Electronics, Information Technology (IT)).

(b) **Post-doctoral scientists** able to assess new developments and apply them in the R&D laboratory.

(c) **Scientific expertise** in academic institutions with whom we can collaborate in order to probe the fundamental questions in our areas of interest.

The Quality of Scientific and Technological Recruits

6. We find that recruits taken directly from university, either as graduates or post-PhD, are often ill prepared for a role in the industrial research laboratory and often lack skills in areas such as report writing, communication/presentation, basic use of information technology and team working and organisation.

7. We believe there is value in a period of industrial training for selected students during the undergraduate courses which equips them for work in the industrial research laboratory. We would recommend the spread of this practice to more universities. We also support training in industry for PhD students through co-operative awards schemes.

The Career Structures for Scientists

8. In Glaxo most scientific and technical staff are employed on a permanent basis and can rise through the company on the basis of their performance and increasing responsibility. Individuals are given the opportunity to develop themselves, within the constraints of the needs of the business, and are rewarded on performance. A scientist working in our laboratories may change their area of research interests a number of times during the course of their career, thus broadening their scientific interests, taking on new challenges and often introducing a different perspective to the problem under investigation.

9. This situation is in contrast to the career structure within the academic environment, where progression of careers and, even employment, is much less certain or stable. An established position is reached usually after a succession of short-term research posts or fellowships. Academic careers are also usually significantly constrained within the relatively close boundaries of individuals' fields of research due to the need for them to acquire a reputation in their field in order to ensure grants and tenured positions. Thus diversification of interest is not encouraged.

10. This system of career progression through a series of short-term grants is not an efficient one because it reduces the amount of effective "research time" in a project. Towards the end of the grant period the individual may be more concerned about finding the next post and may leave the project earlier. The research then suffers when a worker leaves the project early as it is difficult if not impossible to find a replacement for the remaining period of the grant.

11. It is however, important for science-based companies that good scientists do remain in academic research in order to advance fundamental knowledge and to participate in collaborative research projects with industry. We believe therefore, that it is important for industry, the public research institutions and the HEIs that the academic career structure should provide more certainty and security. We believe it is also important that scientists and technologists receive further training during the early periods of their academic career; we suggest that post-doctoral posts should be seen as an essential part of the career progression for the professional scientist, in much the same way as the junior hospital posts are used for the training of medical and surgical specialists and consultants.

12. More emphasis should be placed upon the training of post-doctoral scientists for careers as teachers of their subject in Higher Education Institutions and also in the supervision of junior scientific and technical staff.

Mobility of Scientists and Technologists between Industry and Academia

13. There is little two-way flow of scientists and technologists between academia and the pharmaceutical industry. Scientific staff for the Industry's R&D facilities are recruited from academia but there is little flow of individuals from industrial science back to academic posts. This is due in no small measure to the lack of incentives to transfer in that direction from the point of view of personal position, or from the aspect of infrastructure and resources for research.

14. There are opportunities for academics to gain experience of industry. These include the Teaching Company Scheme, LINK Scheme , CASE and other collaborative PhD schemes and the "Postgraduate Training Partnership" which was introduced in 1992 by DTI and SERC. We believe that these are of value in the right context.

Collaborative research projects and programmes funded by companies such as Glaxo also provide opportunities for academic and industrial scientists to carry out joint research.

Glaxo has developed other arrangements to foster close interaction between academic and industrial scientists and technologists. An example of this is the Glaxo Institute for Applied Pharmacology (GIAP) established in 1991 close to the Department of Pharmacology in the University of Cambridge. GIAP is fully-funded by Glaxo and contains Glaxo and academic staff.

15. UK academics have not until recently been encouraged by their university authorities to establish their own companies to exploit their ideas and technology without having to give up their academic appointment, a factor which has probably played a significant part in the failure of the UK to develop an SME sector in biotechnology. Conditions of appointment should be designed to encourage such developments.

Women in Science

16. There must be policies and mechanisms which encourage girls to consider careers in science and technology and also keep those women who have been trained to continue their careers, or return when family responsibilities allow.

17. We are encouraged by recent evidence that there is now an increasing trend for girls to engage themselves in A level chemistry, but physics and mathematics remain problem areas. It is important that young people are encouraged to take up sciences at A level and degree level, but academic standards in these areas must not be diminished.

18. To encourage trained women scientists to return to work problems such as the provision of help with childcare facilities and also retraining and reskilling for women must be addressed. Glaxo has successfully developed a number of such initiatives to encourage female staff to return to work after maternity leave. We suggest that more part-time employment of women scientists and technologists, for example in teaching roles in HEIs, would enable them to keep abreast of developments in their fields, making later return to a full-time career easier.

19. We suggest that positive discrimination in favour of women in appointing scientific staff is not a way of achieving the desired goal. Career progression for everyone must be on the basis of their expertise, skills and performance.

The Master of Research (MRes) Degree

20. The proposals for the MRes degree must be seen against the background of the present state of undergraduate education and the serious shortcomings in the graduate output from many science degree courses. We believe that this degree has within it the possibility of making good the deficiencies in undergraduate courses, without a universal fourth year, on a selective and purposeful basis particularly with regard to laboratory skills.

21. In establishing courses for the MRes there must be consultation between academics and those industries who will be major "customers" for the product of MRes courses. There is also scope for collaboration between companies and university departments in the provision of the training during the course. We believe it to be essential that the MRes is a scientific qualification in its own right enabling the holder to pursue a career in scientific research within the HEI sector in an industrial research laboratory. To do this the MRes must add real value to the BSc, and provide evidence that MRes graduates have acquired good laboratory skills, are capable of carrying out a research project and have a good knowledge of the subject. The MRes must not be seen as a replacement for the MPhil or be regarded as a "certificate of failed PhD".

22. A further value of the MRes is that it could provide a retraining vehicle for women returning to science, bringing them up-to-date in their field and introducing them to state-of-the-art technology.

23. It is of fundamental importance for the success of the MRes that the necessary funding is available to finance studentships and also ensure the provision of the infrastructure, academic support, and other financial resources, necessary for the quality of training that the MRes should aim to provide.

1. *Introduction*

The pharmaceutical industry in the UK operates in a global market-place and because of this, and its record of producing innovative medicines, it has made a very significant contribution to the Nation's balance of trade over the years. In 1993 its export earnings were in excess of £3.4 Billion. However, it also works in an environment which is highly competitive. A major reason for the success of the industry has been its ability to exploit developments in science and technology to provide medicines of value for the world. The achievement of its high standing in the world-wide market place by the UK pharmaceutical industry is, in no small way, due to the quality of the British science base. The science base is therefore a vital ingredient for industrial competitiveness in today's world and thus economic success.

We believe that companies such as Glaxo must be in a position to maintain the excellence of their scientific and technological research and development activities if they are to continue to be successful. We must be capable of exploiting the explosion of new knowledge of many biological systems that has been made possible by developments within the fields of molecular and cellular biology. Knowledge that is now being gained is throwing new light on a number of disease mechanisms and processes and is pointing to potential new therapeutic targets for the discovery and design of new medicines to cure and prevent disease. For example the international human genome initiative is already beginning to provide a basis for gene therapy for a few diseases; but it has a considerably greater potential for revealing the molecular basis of many more diseases, and for pointing the way to novel small molecular weight medicines. The development of biotechnology has provided new means of producing complex proteins which are now obtainable in quantity and in a highly purified form. This has not only made such proteins available for use as medicines (eg human insulin, epogen, interferons, etc) but is also providing essential tools for drug discovery programmes. The last decade has also seen important advances in chemistry, allowing the synthesis and manufacture of new molecules, or providing new and more effective synthetic routes to existing molecules. Developments in structural and analytical chemistry and in computer science are leading to greater insights into the molecular structure of biologically important substances. However in many cases, it must be admitted, these advances have come out of research laboratories abroad, particularly in the USA, and not the UK.

Well-trained and skilled people are the most important assets that our companies have, and, in the context of the present enquiry, we are particularly concerned with those scientists and technologists who are involved in harnessing new scientific and technological developments for the discovery and development of new medicines. The strength of the pharmaceutical industry in the UK is due to a large measure to the fact that British universities and colleges have been able to produce such people to meet our needs. This nation has not only been able to foster the development of world-class UK companies, but has also attracted many American, European and, more recently, Japanese pharmaceutical companies who have chosen to establish R&D facilities here.

The UK must now be concerned with ensuring that it is able to maintain the position of the nation's science-based industries into the future. Thus we believe that it is of vital importance that our scientific, engineering and technological communities—both in industry and academia—have the necessary strengths and skills to play a major role in ensuring the continued expansion of knowledge. Companies such as Glaxo must also be in a position to take advantage of new advances by exploiting them for the benefit of the health and welfare of the people and economy of our country. There have been signs that over the last 10 years that the UK has been slow to react to the changing climate, and has, as a result, lost the initiative in areas such as, for example, molecular biology and genetics. Glaxo has also become increasingly concerned over recent years at the decline in the quality of science graduates emerging from many of our universities and colleges, and also, in parts of the UK, the dearth of trained technicians for our laboratories. It is important that we understand that the UK is competing, both academically and industrially, in an international environment and so must be prepared to accommodate change and meet new challenges. The training and maintenance of a skilled, imaginative and energetic science and technology community must be a matter of high priority. The traditional methods of training and development of scientists and technologists, which have served well in the past, must be re-appraised and modified to meet the present climate. Some may well have to be discarded. The academic community must listen to the needs of its customers in industry and be prepared to adapt to meet them. Industry, in its turn, must be clear in defining its needs and must be prepared to play its part in maintaining an effective science, engineering and technology community. We therefore welcome the Select Committee's enquiry and the timely focus it will bring to what we believe is a crucial issue.

In this submission we confine our comments to those issues surrounding academic careers, and the training for them, as they affect Glaxo, and offer some of our experiences of the important interface between industry and academia. There are others more competent than us to discuss questions raised by the Committee which are more directly concerned with issues within the academic sector.

2. *Glaxo's need for Scientists and Technologists*

From the introduction provided above it is clear that Glaxo, along with its sister companies in the industry, looks to our universities, colleges and research institutions to provide well-trained and skilled scientists and technologists. We can define three broad needs that we have:

(a) For *graduate scientists and technologists* who have the necessary knowledge of their particular branch of science or technology, who can apply this knowledge to good effect and who are capable of working in the research laboratory or parascientific environments. Examples include individuals experienced in robotics, electronics and Information Technology.

(b) For *post-doctoral scientists* of a high intellectual calibre who are able to assess new developments in their fields and apply them in the laboratory for the discovery and development of new medicines.

(c) For *scientific expertise* in academic institutions with whom we can collaborate in basic research to probe fundamental questions such as those we must answer in order to understand normal cellular and molecular processes in the body and their modification in disease states. However for successful collaboration there must not only be the right expertise but also the willingness to create research partnerships which can be fruitful.

Our particular needs to recruit scientists and technologists will vary from time to time depending upon activities within our R&D organisations. Thus in the last three years, following a major expansion in scientific and technical staffing during the 1980s, we have recruited between 21 to 41 scientifically qualified staff per year directly from Universities into Glaxo Research and Development Ltd (GRD Ltd) about half of whom have been new PhDs or post-doctoral scientists. The period of expansion was to permit Glaxo to acquire the necessary expertise to provide us with a critical mass of people with expertise to allow us to enter areas of developing science such as in molecular and cellular biology and biotechnology. It is during such periods of expansion into new fields that we found greatest difficulty in obtaining personnel with the right qualifications and experience. However, finding suitable staff is less of a problem for the major companies when recruitment is on a predominantly "maintenance" basis and we are able to choose from amongst the best applicants. It is thus easy for large companies such as ours to not fully appreciate the problems encountered by smaller companies who are not in the same position.

3. *The Quality of Scientific and Technological Recruits*

We find that recruits taken directly from university, either as graduates or post-PhD, are often ill-prepared for a role in the industrial research laboratory. We have been able to identify some of the problems that are commonly encountered as a result of surveys we have recently undertaken amongst graduate and post-doctoral scientists recruited in the last three years, and their managers. We offer the Committee some of the findings that have emerged from this survey for its information.

(a) *Managers* in the R&D and other technical areas of the Glaxo organisation were almost unanimous in reporting short-comings in new graduate recruits from a range of UK universities, from both the "old" and the "new" sectors. The most serious deficiency is the lack of experience of laboratory work. Often graduate scientists are found to be unable to carry out routine laboratory operations when they first arrive and so a significant amount of time has to be spent in bringing these recruits up to a satisfactory level with regard to their laboratory skills. New graduates also often lack skills in such areas as report writing, communication/presentation and, in many cases, basic use of information technology.

Our managers were unanimous in declaring the value of, and their support for, a period of industrial training during the undergraduate course. Students who had benefited from such courses, either through formal sandwich courses or through a year's release, are well-equipped to work in the industrial research laboratory and are generally effective from the start of their employment. We would recommend the spread of this practice, on a selective basis, by more universities, particularly in the "old" sector.

(b) Of the 118 *graduate scientists* questioned, 72 were employed in science or technology roles and less than 20 per cent of these felt able to claim that their university course had fitted them "very well" for their jobs. Fourteen per cent admitted that their courses had fitted them "not very well" or "not at all well". The bulk of the graduates were prepared to say that their training had fitted them "quite well". When asked what areas their training, as a preparation for work, was deficient in the most commonly mentioned were presentation and communication skills, team working, the use of IT and development of organisational skills.

(c) In the case of new *PhDs* the absence of significant laboratory or IT skills is not usually a problem but they are often found to lack the ability to organise their work and time. In our survey of 37 PhDs about 30 per cent replied that their PhD course had fitted them for their industrial role "very well". However, they highlighted, as gaps in their training, the modest amount of training received in report writing, communication/presentation and time-management skills. The most serious deficiency is the lack of significant team working experience. This is an important aspect of the industrial research environment and clearly the PhD degree course, in most UK universities, does little to encourage this. We are pleased to note however that there is a recent trend for some university departments to include training in these aspects in their PhD courses, and for them to seek an input from industrial scientists.

Glaxo has, at present, little trouble in recruiting post-doctoral staff and thus we realise that those joining the Company may not be generally representative. We have therefore asked those managers with experience of the process of selection of PhDs for employment for their opinions about the general standards of applicants. The general view was that less than 20 per cent of those applicants considered were up to the standard sought by Glaxo. There was, moreover, a general feeling that the standard of the PhD was either static over the last five years or had declined but not improved.

In order to correct these skills deficiencies in both new graduates and post-doctoral scientists the Training Department within Glaxo Research & Development Ltd organises regular courses to provide new recruits with training where skills are lacking. The department also provides training for staff throughout the development of their careers to fit them for increasing or new responsibilities, such as research supervision and team leadership roles.

4. *The Career Structures for Scientists*

(a) Industrial career structures in Science & Technology:

In Glaxo, most scientific and technical staff are employed on a permanent basis. They are placed onto the appropriate point on the salary scales and can rise through these scales on the basis of their performance and increasing responsibility. Our grading structures are designed to allow the individual the greatest opportunity to develop within the constraints of the needs of the business and be rewarded on performance. Thus an individual on the scientific staff may choose to follow a career as a research scientist, aspiring to lead project team(s), or as a specialist within their area of expertise or to opt for a role in science management. The field of research in which scientists in Glaxo may work may change a number of times during the course of their careers. Thus they have opportunities to broaden their scientific interests and take on new challenges. This also has benefits for the projects in which they become involved because it can introduce a different perspective to the problem under investigation and suggest new directions or approaches.

There are also opportunities for our science graduates to move out of the laboratory environment and into other areas of the company's business, such as, for example, into the regulatory, information sciences, commercial or other functions. Within Glaxo, staff including graduates, are encouraged to continue their education and at present about 10 per cent are following courses leading to further qualifications. All staff also undergo regular appraisal of their progress and, as a part of this, career development reviews are undertaken. Glaxo also offers career counselling for staff who request it to determine suitability for other occupations.

Within pharmaceutical companies there is usually a flow of scientific and technical staff into different functions in the company, but there is also a flow of personnel between companies within the industry and also between the large companies and the smaller SMEs in the biotechnology sector.

(b) Academic career structures in Science and Technology:

In contrast to the career structure within the industrial environment, the progression of careers and even employment within academia is much less certain or stable until an established position is reached, often after a series of short-term research posts or fellowships. Careers in academia are also usually marked by being constrained within the relatively close boundaries of the individual's field of research and there may be a career danger in moving into a new field. This situation is conditioned by the need for the individual to acquire a reputation in his field in order to ensure his next position or grant, and this generally militates against diversification. This also tends to lead to the prosecution of short-term projects that will provide results for publication to bolster the individual's Curriculum Vitae and competitive academic position. Thus the system operates against more difficult, long-term, areas of research in which fundamental advances are needed but which will not come easily.

The weakness in the present academic career progression, through a series of grant and contract supported post-doctoral positions, lies in the employment uncertainty that is created for the individual scientist before an established post is achieved. This system is also not an efficient one because it often reduces the amount of effective "research time" in a project. Towards the second half of the grant period the individual begins to be concerned about finding his or her next post, and may leave the project earlier to take advantage of other opportunities. This is a situation we encounter in post-doctoral projects we support in university departments. Once the researcher has left the project it becomes difficult, if not impossible, to find a replacement of the right calibre who is prepared to take the work on for the remaining period of the grant. In earlier days, when there were fewer post-doctoral scientists, and relatively more grant funding available, a more stable early career was possible in academia, and the attainment of an established tenured post also came sooner than now. However, one benefit which derives for industry from this otherwise unsatisfactory situation, is that more post-doctoral scientists are now prepared to embark on careers in industry.

It is important for science-based companies, that good scientists do remain in academic research in order to advance our fundamental knowledge, and to provide the partners for our collaborative projects and programmes. In the medical sciences in particular it is essential that there is high quality fundamental research being carried out in the clinical environment in academia to provide the foundation of new drug discovery programmes. This was not so true in the past when animal models and tissue culture systems were adequate for drug discovery research and the industrial laboratory could be largely self-sufficient. This in no longer the case. To take advantage of advances in the understanding of disease processes, by harnessing new knowledge for the discovery of disease-modifying or curative medicines, we must have effective research partnerships with academia. We anticipate that, with the increasing rate of discovery of novel cDNAs and molecular leads from combinatorial chemistry, there will be a significantly increased need to develop partnerships with academic groups having relevant model systems which will allow the analysis of the function of these new molecules.

We believe, therefore, that it is important for industry, the public research institutions and the HEIs, that there is an academic career structure that will provide more certainty and security. It is also of importance that scientists and technologists receive further training during the early post-doctoral period of their academic career. We suggest therefore, that post-doctoral posts should be seen as an essential part of the career progression for the professional scientist, in much the same way as the junior hospital posts are used for the training of medical and surgical specialists and consultants. Post-doctoral fellowships should not be seen simply as research assistant positions for particular research projects. We welcome the emphasis that is now being placed upon the provision of further training during young scientists' post-doctoral period by the Research Councils within their Fellowship schemes. There is a strong case for the selection of bright young PhDs for higher research training and career development who would be given a reasonable degree of certainty with regard to the continuance of their support for at least six years, subject to performance, and the prospect of a tenured position thereafter. Such arrangements would allow the person to undertake a more substantial and challenging research programme than is at present the case.

The financial rewards that attach to careers should not be ignored as they are important not only for the individual's satisfaction but also indirectly condition the status of the individual as perceived in the wider community. It may be suggested that present university salary levels, both in respect of post-doctoral and more permanent appointments, are a disincentive to a career in academia. Salary and benefits packages for research scientists within the pharmaceutical industry reflect the value which companies place on their R&D staff. This is an issue which needs to be addressed if the best young scientists and technologists are to be attracted into academic research and retained.

There is also a case to be made for a second avenue of training for post-doctoral scientists leading towards careers as teachers of their subject in Higher Education Institutions (HEIs). At present the university teacher receives very little, if any, training in lecturing and teaching skills. There is also a need for training to be given in the supervision of junior scientific and technical staff such as PhD students, research assistants or post-doctoral fellows. We are pleased to find that a number of universities are now starting to provide training for this function. We believe that in the future there will be a development of teaching and research centres within the science base, and it is essential that the highest calibre of professional scientists and technologists are available and that in both we have "centres of excellence".

5. *Mobility of Scientists and Technologists between Industry and Academia*

There is little two-way flow of scientists and technologists between academia and the pharmaceutical industry. The scientific staff of the industry's R&D facilities are recruited from academia, mostly at the graduate or early post-doctoral level. However, from time to time more senior academic scientists are also recruited, including individuals at the Professorial level. There is on the other hand little flow of individuals from industrial science back to academic posts. This is no doubt due, in no small measure, to the lack of incentives to transfer in that direction either from the point of view of a personal financial position, or from the aspect of the provision of infrastructure and resources for research. As far as flow in the industry to academia is concerned, we see this as a much less important issue as long as effective means are available to enable academic scientists to have experience of the industrial research environment.

There are various such opportunities for academics to gain experience of industry and return to their HEIs whilst at the same time allowing the company to benefit from their expertise. The Teaching Company Scheme is one arrangement which encourages such industry/academic interaction. However, it is one which is more suited to the needs of smaller companies which have more limited R&D resources, and availability of an expert from academia can bring significant added value. This scheme has not been used by Glaxo as it is less appropriate to a large company with its own very significant in-house R&D facilities.

Another well-established scheme is LINK which can lead to a significant degree of interaction between industrial and academic scientists whilst allowing the individuals involved to remain within their own respective institutions—academic or industrial. In our experience a well-managed LINK programme allows the free flow of ideas between the members of the collaborative partnership and also provides the academic scientist with insights into the objectives, methods and requirements of industrial R&D. More recently the "Postgraduate Training Partnership" was introduced in 1992 by DTI and SERC to encourage collaboration between universities and Independent Research Organisation in the training of post-graduates (PhD students) at the interface between academia and industry. The first tranche of students are due to come out of this scheme in the summer of 1995 and we should then be in a position to begin to evaluate its success. Large, non-IRO, companies were however excluded from this scheme which may have limited realisation of its full potential.

Glaxo has used other available schemes, and has also developed other approaches, which we have found to be of value in bringing about interaction between industrial and academic scientists, to which we have committed significant funding for many years.

(a) The CASE and other collaborative PhD studentship schemes provide an opportunity for young scientists to gain experience of industry. This is achieved firstly, through the provision by the company of an industrial supervisor for the student who is jointly responsible with their academic supervisor for the student's research training. Secondly, the scheme requires the students to spend a minimum amount of time during their research projects working in the industrial laboratory: in our experience the students invariably spend considerably more than the minimum time in our laboratories. The student not only gains some insights into the nature of research and development activities in the industry, but also has access to equipment, and other resources, that may not be available in their university laboratory. At the end of the training the student may be recruited into the industry as a result of this experience. Where the student elects to follow a career in academia they can take these insights of industry into their own research and teaching activities.

A further benefit that accrues from the collaborative studentship is the relationship that develops between the academic and industrial supervisors. Thus the academic regularly comes into close contact with company scientists and gains a knowledge of the industrial research environment and its needs which, we hope, will be reflected in their work in the HEI. A significant number of our larger collaborative research projects have arisen out of collaborations with PhD students.

Glaxo has been continually involved in the CASE scheme since its inception by SERC, and during the 1980s we established our own fully-funded PhD studentship and scholarship schemes based on the collaborative principle. Glaxo currently supports over 230 PhD students either through our own schemes or a Research Council scheme at a cost to Glaxo of over £2 million per annum.

(b) Collaborative research projects and programmes provide an opportunity for Glaxo and academic scientists to carry out joint research programmes, usually in an area of basic research. These collaborations will normally be established through a grant from Glaxo to support a post-doctoral scientist working in the HEI under the supervision of an established academic scientist on a defined project of mutual interest. Close interaction between the industrial and academic teams is regarded as essential in order to create an effective synergy between the two groups. Currently GRD Ltd supports over 170 such projects of which 132 are with UK universities and research institutions at an annual cost of about £5.5 million.

More recently we have engaged in more extensive programmes of collaborative research in areas of basic science. The most recent of these is our *"action tb"* programme. This involves research groups in three UK university departments, five academic departments in the Republic of South Africa and Glaxo's TB research team. This is a programme in which our external funding is committed for five years allowing greater personal stability for the researcher and the possibility of more in depth research. It will involve a minimum cost to us of £10 million over that period for the external elements of the programme.

(c) We have over the last four years been active in exploring other more direct means of fostering close interaction between academic and industrial scientists and technologists. In 1991 we established the Glaxo Institute for Applied Pharmacology (GIAP) which is situated within the same building as the Department of Pharmacology in the University of Cambridge. GIAP is fully-funded by Glaxo. This Institute is staffed by members of Glaxo's scientific and technical staff (including the Director) but it also has, at present, eight post-doctoral fellows working full-time in the Institute. These are employed by the university and are appointed jointly by the Department and the Institute and are funded by grants to the university from Glaxo. This arrangement we believe ensures that the post-doctoral scientist remains on his academic "ladder". Similarly there are up to 10 PhD students in the Institute who receive Glaxo studentships. The members of the Institute mix freely with staff from the University Department of Pharmacology and are also developing collaborative links with other departments and research establishments around Cambridge. They are free to engage in collaborative research projects, attend the Department's seminar programmes and the Director, who holds a Professorial title in the University, delivers lectures to under-graduate courses in the Department. The Institute also provides a bridge between the scientists in the department and Glaxo's main research divisions, soon to be located at our Medicines Research Centre at Stevenage. We believe that this initiative is proving to be a very valuable way to bring about a flow of people and ideas between the two sectors.

We have since established smaller-scale "research implants", with similar motives, in the University of Hertfordshire to encourage the development of new technology for *in vitro* toxicology. We are now in the process of establishing a further Glaxo group in the Department of Chemistry in the University of Cambridge on a similar basis to GIAP.

Therefore, opportunities for interactions and flow of ideas and technology between academia and industry do already exist and can be of value if they are made use of. We have also found a willingness on the part of academic scientific staff to engage in such collaborations. Mobility of people between the sectors is, however, mainly in one direction and one reason for this is likely to be the lack of attractiveness of a career in academia to the industrial scientist. One factor that has probably played a significant part in the failure of the UK to develop a SME sector in biotechnology, until recently, has been that UK academics have not been encouraged by their university authorities to establish their own companies to exploit their ideas and technology without having to give up their academic appointment. This was not the case in the USA where the extensive biotechnology industry is made up of small companies established by academic scientists whilst continuing their academic careers. The situation is now changing, however, but the failure of academia to respond to new developments has resulted in the UK lagging behind our US competitors. It is ironic that we now find examples of US biotechnology companies "cannibalising" UK academic research; Glycan Pharmaceuticals for instance has tied up the glycobiology interests in the University of Manchester. The great majority of Glaxo's strategic alliances have been made with biotechnology start-up companies in the US because there were no candidates for these alliances in the UK, or indeed Europe.

6. *Women in Science*

We believe that the development of careers in science, engineering and technology for women is an important issue. There must be clear policies and mechanisms which encourage women to consider science and technology as a career, and more particularly to keep those who have been trained in these areas to continue their careers or return when family responsibilities allow. Failure to establish such measures will result in a significant waste of human resource in which the nation has invested significant time, facilities and funds to train.

Recruitment of girls into the biological sciences during their A level school careers has never been a serious problem, however chemistry and the physical sciences have been areas that girls have shown reluctance to enter. We are encouraged by recent evidence that there is an increasing trend for girls to engage themselves in A level chemistry, although they have not yet reached parity with boys. Physics remains a problem area as does mathematics, although the latter is a problem in the case of both sexes. It is of course important that young people generally are encouraged to take up sciences at A level and degree level, but that at the same time the academic standards in these areas must not be diminished.

It is important that career structures in science and technology, whether in industry or academia, do not discriminate against women, however it must be recognised that, for many, it is inevitable that family responsibilities will lead to career disruption. Steps can be taken to minimise this through help with childcare facilities, enabling early return to work, and also retraining and reskilling for women returning to science later in life. GRD Ltd assists its female staff to return to work after maternity leave by providing advice and some financial support for childcare arrangements; the company also operates a number of other schemes to facilitate return to work including phased returns, work-sharing and part-time appointments. More part-time employment of women scientists and technologists, for example in teaching roles in HEIs, would enable them to keep abreast of developments in their fields making later return to full-time career easier. We suggest that positive discrimination, in favour of women, in appointing scientific and technical staff is not a way of achieving the desired goal. Career progression for everyone must be on the basis of their expertise, skills and performance. However, it may be suggested that more women scientists will come to occupy higher positions as more of them do return to work earlier and as they put themselves forward for such positions.

In Glaxo's UK companies about 39 per cent of our 12,230 staff are females. In GRD Ltd, in which there is the highest concentration of scientific and technical professional staff, the overall proportion of women at the start of 1995 is over 46 per cent in a total staff of 3,644. In the lower scientific grades there are almost equal proportions of men and women but the ratio changes in favour of men in the higher grades, although women do now account for about 20 per cent of those staff in supervisory and management grades. Women at present make up about 17 per cent of GRD Ltd's senior management grades (which include managers, senior scientists and specialists) which, compared with the 10 per cent in such positions in 1989, represents a growth in numbers of women achieving higher positions in that company. It is of interest to note that of the 137 women in the supervisory and management grades 57 hold PhDs and the remainder are graduate scientists. It may be anticipated that as the environment increasingly encourages and supports women returning to work their numbers in science and technology will continue to rise and they will increasingly come to occupy senior positions. There is no reason why the same principles should not apply also in academic institutions and result in an increase in number of women achieving eminence in science and technology. Research Councils, other funding bodies and the HEIs should be encouraged to take steps that encourage and support women scientists wishing to return to academic science.

7. *The Master of Research (MRes) Degree*

We believe that it is important that the proposals for the MRes degree should be seen against the background of the present state of under-graduate education in UK HEIs and the serious shortcomings in the graduate output from many of the science degree courses. Our concerns about the decline in quality and suitability of graduates emerging from science and technology courses for careers in research have already been mentioned above. Of particular concern are the falling levels of practical laboratory skills already discussed. We believe that these shortcomings are due to a number of factors among which are:

- the ever increasing science syllabus which is being addressed which puts pressure on timetables;
- the mounting pressures on the universities from the Government to increase the numbers of students taking science courses;
- a failure of Government to provide the increased funding required to supply and maintain the infrastructure required for teaching practical science; and
- failure of universities to provide adequate practical laboratory experience for the students. We recognise that such practical training is now expensive both with regard to teaching staff commitment and also materials, and requires a reasonable level of provision of laboratory facilities.

In Glaxo's submission to the Chancellor of the Duchy of Lancaster during the consultation which preceded the White Paper *"Realising our Potential"*, we proposed a two-tier, four-year degree system for science and technology. Such a system we believed would allow a greater focus of the resources available for education and training in science and technology on those intending to practice science and technology and provide them with in-depth knowledge and good practical laboratory training in their discipline. At the same time it recognises that there are many undertaking degrees in science who will never practice science in their professional lives, but for whom a working knowledge of one of the scientific disciplines, and the scientific methodology, will be of value but who do *not* need to have detailed exposure to the laboratory environment. We are concerned that these objectives will not be met by merely extending the present three-year degree courses for a fourth year for all science under-graduates, this would fail to concentrate the limited available resources where they would be most productive. The White Paper did not propose any changes in the present under-graduate courses. It did propose what has now emerged as the MRes.

We believe that this new degree is worthy of careful consideration because it has within it the possibility of making good the deficiencies existing in present under-graduate courses, without the universal fourth year, on a selective and purposeful basis.

In the process of establishing courses for the MRes we suggest that there must be consultation and discussion between the academics and those industries whose needs they seek to meet and who will be major "customers" for the product of MRes courses. There is also scope for collaboration between companies and the university departments in the provision of the training during the MRes course: projects being undertaken within the laboratories of an industrial partner in appropriate cases and industrial scientists involved in some of the taught elements of the courses. Thus MRes could be seen not only as producing well-trained scientists for research careers but also as a conduit for the development of academic/industry collaboration. A further value of the MRes, which has not yet been highlighted, is that it could also provide a valuable retraining vehicle for those women returning to science after a period of raising a family, bringing them up to date in their field and introducing them to state-of-the-art technology.

We consider it to be essential that the MRes is seen as a scientific qualification in its own right enabling the holder to pursue a career in scientific research, either within the HEI system for a PhD or as a member of an industrial research laboratory. It must not be seen as a replacement for the MPhil or be regarded as a "certificate of failed PhD". The clearest way to avoid this is to ensure that the MRes is a well-constructed and useful course, with standards to be met which are validated and accredited. It must be awarded as a distinct degree which provides a route to a research career in industry or commerce in its own right as well as a qualification for entry to the PhD course.

We would regard it as essential that the course should contain a significant amount of laboratory training, occupying at least 60 per cent of the student's time, during which they will acquire practical skills and be stretched by a research project. Members of academic staff must give the students guidance and supervision of their project work at least as carefully as if they were PhD students. One characteristic of the MRes graduate would therefore be a good level of laboratory skills. The MRes should also contain, as a second important component, taught courses designed to deepen the students' understanding of their subject, or discipline, and its potential. The taught element, for example, could also afford an opportunity to provide those students intending to pursue a career in medical research with a knowledge of those diseases on which they hope to work. Finally, the student should be given experiences to develop the other skills such as report writing, time management, communication/presentation, use of IT and team-working which our survey highlighted as deficiencies in present graduates.

If the MRes is to be successfully introduced and shown to be a useful qualification then it is of fundamental importance that funding is available not only to finance studentships but also to ensure the provision of the infrastructure, the academic support, and other financial resources, necessary for the quality of training that the MRes should aim to provide. It must be clear that to achieve its aim the MRes must add real value to the BSc, and provide strong evidence that the MRes graduate has acquired good laboratory skills, has shown him/herself to be capable of carrying out a research project and has a good knowledge of his subject. If holders of the degree possess these qualities then Glaxo's scientific and technical departments would probably regard such graduates as important targets for scientific recruitment. In our survey of managers, referred to above, we specified the MRes as a degree containing the element just outlined and asked them whether they would employ such graduates. In GRD Ltd 28 of 31 managers consulted said they would employ people holding an MRes; 25 indicating they would see them as replacements for first degree graduates in some functions. Four mangers saw them as fitting some roles currently performed by PhDs. In the operating companies (manufacturing and marketing) 12 managers replied that they would employ MRes graduates—mainly in roles currently undertaken by graduates—eight were undecided and nine did not consider the MRes was appropriate for their functions.

We are therefore supportive of this new approach to post-graduate training and believe that the output from MRes courses should be of value to us. We believe it will also be of value to other companies in the pharmaceutical industry, despite their general negative reaction during the consultation period. We shall watch the development of the pilot courses with interest and will become involved with academic colleagues in their design and execution. There is clearly a gap in current scientific education and training, that is of concern to industry, which the MRes can bridge. We also hope that the pilot courses will show the added value that the MRes should be capable of bringing to science and technology graduates and that it will in due course become an accepted, respected and valued British qualification.

8. *Conclusions*

It is our view that the success of our company, and others in the pharmaceutical industry, is due to a significant extent to the fact that HEIs and research institutions in the UK have been able to provide us with a steady flow of well-trained people for our scientific R&D activities. We have also been able to find good collaborators within these institutions to carry out basic research we need, and over recent years there has been an increasing willingness for academic scientists to work with industry. This interaction is becoming increasingly vital for the success of companies such as Glaxo, and others in science and technology based industries. Therefore we must work together to ensure that this state of affairs can continue into the future, so guaranteeing the wealth that is needed to sustain the public sector science-base that the nation requires to meet the challenges of the next century. An effective science-base will also encourage inward investment into the UK by overseas companies, as is well-demonstrated by the pharmaceutical industry.

We have however been concerned, as outlined above, at a decline in the standards of training received by young scientists in our HEIs particularly in the practical skills they need for a career in a modern research or development laboratory. To ensure the successful employment of their student outputs, whether at graduate or post-graduate levels, the HEIs must now begin to address the needs of their "user" community to ensure they are producing what the customer wants. At the same time they should also re-evaluate what they themselves should be developing in the academics of the future

We believe that there must be a closer interaction between academic and industrial scientists and technologists and that this may be accomplished by a flow of staff between the two sectors. However, effective interaction and understanding can also be achieved, we submit, through the development of effective collaborations between the two sectors. Schemes which encourage this are deserving of support and barriers to collaboration must be removed and certainly no new ones should be erected.

Finally, we recommend most earnestly that due attention is paid to the proper development of the careers of our nation's best young scientists: selecting them for development and training to a high level in science and technology, and assuring them of a worthwhile and rewarding career in academic research or teaching. The Research Councils, Higher Education Funding Councils and other funders of academia must address these issues seriously and develop new schemes to meet this objective. Industry too must also play its role in the process by being prepared to enter liaisons with the HEIs, in both teaching and research arenas, to bring about a clearer understanding of its needs and problems. If we are to compete in the highly technological and competitive world in which we operate, both sectors must also take steps to ensure that the UK has the necessary breadth of outlook in its science, a readiness to move into new areas and a flexibility of approach to problems that we will need to address. New approaches are very likely to challenge convention and tradition. The ability of the scientific community to make the choices between "new", and unknown and probably risky ways, and the "old", but well trod, comfortable and cherished, will in no small manner determine the future success of the UK industry in the modern highly technological world.

27 January 1995

Evidence from Dr Susan Greenfield, Department of Pharmacology, University of Oxford

1. There are several problems facing academic scientists in the UK in terms of current career structures. First, the pyramid of promotion, whilst inevitable, is too sharp: large numbers of young scientists are recruited initially to doctoral degree programmes: however, the selectivity process for postdoctoral positions and then for tenured lectureships leads to far too much of a fall off of young people too early on. The prospect of little money, irregular hours but above all no security at all is less than appealing for many. Secondly, there is no obvious career path. Of the relatively large numbers completing doctoral degrees only a few end up as lecturers and even fewer as long-term, full-time research scientists. There is no alternative way to ensure a scientific career, no provision for a relatively secure post in which an individual could contribute to a research team without necessarily leading it. Perhaps the biggest problem is that, unlike in other professions, lack of promotion most usually does not mean merely remaining in a current post, but being employed. It is true that some funding bodies sketch out career paths in their booklets. Such diagrams omit the fact that the individual either moves up, or out. Probably those worst affected are not so much graduate students who can and do enter all manner of jobs, after what might be regarded at the very least as further disciplining of the mind, but rather those in their early thirties who have already been in one or two postdoctoral positions. Such individuals, who by that time most usually have a mortgage and a family, feel that they are already committed as scientists but, at the same time, they have no security at all. The chances of these highly trained specialists actually gaining a tenured position in the public sector becomes increasingly slight in the face of a burgeoning new generation of cheaper-to-employ personnel.

For the minority who do gain tenure, another type of problem arises. Having been elected chiefly on research strengths, the new lecturer is beset with teaching and administrative duties which seriously jeopardise a hands-on contribution to experiments. Such a scenario is inevitable and unavoidable, but the degree to which research time is eroded could be addressed. I can only speak for Oxford, but would make the following, fiscally neutral, suggestions that might well apply to other universities: (1) Allow practical class teaching to be run under the direct supervision of graduate students, for whom the teaching experience will be valuable. Lecturers would design the class and act as general adviser to the graduate students. This arrangement would free up as much 25 per cent of a lecturer's timetable. (2) Publicise and encourage scientists to seek temporary (eg up to five years) "buy-outs" from industry or other funding bodies whereby the lecturer's salary is met by this external source whilst the University funds a temporary lecturer. Since the temporary lecturer will inevitably be younger that the permanent one, the University will make a saving: moreover the salary paid by an industry would attract substantial overheads, in the case of Oxford this is 42 per cent. (3) Money accrued in (2) could be used to pay for university funded research leave, new posts or payment for graduate students in practical classes (see 1). (4) Tutorial teaching, in the cases of Oxford and Cambridge, could be abolished in the instances where facts rather than ideas are emphasied ie in preliminary courses. The classic tutorial of one student, one tutorial, could be reserved only for the final honour school component of the courses where interpretation and open ended discussion are at a premium.

The one advantage for tenured staff within the current structure is that one actually is exposed to teaching. When I compare our system with laboratories in which I have worked, in both New York and Paris, I have the impression that English scientists, on the whole, are both more rounded, and express themselves more lucidly, than their foreign counterparts.

2. The disadvantage of short-term research contracts is, of course, that they offer the scientists in question no security. Even for those tenured lecturers who are not directly employed on short-term research contracts, there is the tendency to do "safe" research, such that one can have publishable results within a relatively short period of time and, therefore, be in a strong position when applying for further grants. The other problem with short-term research contracts is that one might spend the first year setting up, only the second year being productive, but the third year applying yet again for money. This bureaucracy, for which it would take just as long to do a five year application as a three year one, let alone a two year one, is a serious encroachment on one's time. The advantage, I suppose, is that no money is "wasted", ie if the research is poor then clearly one does not spend many years subsidising it. On the other hand, if we had a more widespread rolling system of review rather than re-application, there would be a certain amount of insurance against long-term funding of poor research, but a longer time period over which a scientist could explore more innovative approaches.

3. I envisage that the situation in the next decade is going to deteriorate. As science becomes ever more technological, it becomes more expensive and, therefore, the grant money available ever more coveted. Those sitting on grant giving bodies adopt an increasingly cautious attitude to endorse "safe" research, which is a paradox in terms. I have seen reports on grants where priority is given to whether experiments will definitely "work", namely whether the results are more or less already known. Such an attitude is contrary to the idea of experimentation and, although it will generate results which will appear publishable, it is not necessarily addressing the serious and deep questions which obviously entail a certain risk of being wrong. Being wrong often leads to the most exciting findings of all, eg Fleming discovering his cultures would not grow due to the "mould" of penicillin. I foresee an environment in which there is a decreasing chance of allowing scientists to be wrong.

A further aspect of scientific research in the next decade is that there will be a dearth of good people: many of the brightest undergraduates are not attracted to science, possibly due to the issues discussed in (1). I was astonished when recently exposed to the world of the media at how enterprising, sharp thinking and insightful many of the junior people were, compared to many of their peers in the scientific milieu.

4. Of the 10 graduates I have supervised, who have not continued in the contract research sector, the remainder have either entered the private sector pharmaceutical industry or, and this is the majority, have returned to practising clinical medicine.

5. Already the transition from academia to industry is acceptable, and established, and I see no problems with mobility in that direction. However, it is very much a one way street. The problem, of course, is that for those returning to academia there is a need to gain grants for which they need to have publications. The publishing of papers however is not the priority for industry. Perhaps one way to help those who have been in industry and wish to return to academia, would be to set aside special re-entry grants, where the qualification is not publications, but more where the applicants have acquired certain specialist skills and have an interesting project to pursue. These criteria, coupled with references and university track record, could be used rather than the number of publications.

6. I cannot see how the situation for women in science is going to change unless radical improvements are made. One step could be a scheme, which I gather has been considered already, for those who have had full time care of a child: such a scheme would most probably involve mostly women, but would not preclude men. Money would be ear-marked for such individuals, who again would not have a strong record of recent publications and would be a little like the scheme outlined in 5. The big problem for women in science is not so much as to whether they are employed in labs: there are many women in labs, but they are in the main employed as technicians or junior research assistants. A reason for this dearth of senior women scientists is that part-time research posts, or the fixed hours of technical posts, fit very well with looking after children. The issue then is to have a scheme whereby women can be helped to come back into science *and take charge of their own groups.* The re-entry scheme outlined would be one way for them to re-establish themselves after a period of child care.

Any problem is that, in my experience, women on the whole tend to be less assertive than men. This is a problem not for actually doing science itself, but rather for being confident enough to stand up to criticism and to fight for what one wants. Perhaps courses in assertiveness training could be made more widely available to women.

Another issue is the problem of women on selection committees. Because they are such a minority, few women *pro rata* serve on selection committees: hence male dominated committees feel more comfortable interviewing and, indeed, recruiting other men. Perhaps some system could be organised whereby the few number of scientific women are "bussed in" to serve as external assessors where there is currently only a token woman on existing committees. I, for one, would be happy to do this to a certain extent and many of my female colleagues in Oxford, I am sure, would be happy to help in this way. One might even imagine a central register of senior women scientists available to selection committees.

7. I have recently been involved in helping Dr Nick Rawlins (Department of Psychology) with setting up an MSc in Neuroscience in Oxford. I am happy to attach the course plan together with the chequered history of our endeavour which reflects the havering of the MRC due, in turn, to pressure from the government. We have now converted this course to accommodate the provisions of an MRes.

In general, I think a one year degree where the emphasis is on research, presents the following problems:

(i) At least in Oxford an MRes could be conflated very easily with the 4th year of biochemistry or chemistry BA degree and I think this will lead to no end of problems in distinguishing an MRes from a first degree.

(ii) It is very hard to get a serious research programme successfully launched and completed within one year.

(iii) If people are just doing a one year course then there is great need for them to have a more structured idea of scientific method, practice in laboratories and, indeed, some core facts that may not be there as a direct continuation from their first degree. I would therefore urge to substitute MRes for a fuller adoption of MSc degrees where there is greater flexibility in designing a course to mix formal teaching with research as appropriate to the aims of the course and the needs of the students.

Evidence from Dr I Hardalupas, Mechanical Engineering Department
Imperial College of Science, Technology and Medicine

Preface/Summary

Research scientists in the universities are working with low salaries, bad career prospects and low job security. Their insecure position has been worsened by the reduced research funding. Although the career structure and the short term employment may be advantageous for researchers who wish to work in the industry, researchers who wish to remain in the university suffer from inequalities between permanent academic staff and research staff, from the insecurity of the short-term contracts and the chance of becoming unemployable by the industry, while the university does not offer them permanent positions.

The employment conditions, the career development and the self esteem of research scientists can be improved by:

(i) setting a time limit of six to eight years in the employment of researchers in universities without any commitment by their departments to offer them a permanent post;

(ii) introducing a career review procedure;

(iii) establishing active participation of the research staff in the departmental decision making process; and

(iv) granting them the right to sign research contracts.

All the above should be followed by the research councils funding more long-term fellowships to improve the security and the status of the research staff. The funding for the fellowships should come from efficient re-allocation of current research funds to few universities with good research background and links with the industry.

Most of the researchers who leave the short-term contract university research go to work in the industry or in the financial sector. A large number of overseas researchers return to their countries. It is only a small number of researchers remaining in the university as permanent staff.

The co-operation between universities and industry must be improved to allow for better mobility of scientists to the industry. The research councils should initiate a procedure of meetings on particular subjects, where industry and university researchers will agree on common research, which will be funded by the councils and partly by the industry. The industry should financially support a researcher working on the project funded by the council with the agreement that the researcher will work for the industry after the end of his research contract. However, industry must become more committed towards research with long-term targets to improve the employment prospects in industrial research laboratories and attract charismatic researchers.

Women involvement in university contract research can only increase by offering more long-term contracts. In this way, maternity leave over periods of three months can be arranged by stopping the research for this period without replacing the main researcher by temporary staff, which is difficult to find, and without increasing the cost of research. Of course, this will mean more commitment by the main researcher during the remaining period of the contract to cover the time lost.

The above suggestions are explained in the following text.

Advantages and disadvantages of the current career structure and of the short-term contracts for research scientists in the universities

The career structure and the existence of short-term contracts affect mainly the researchers who wish to remain in the universities and join the permanent staff. The researchers who wish to remain in the university for a limited period of time and do not wish to join the university permanent staff are not significantly affected by the current employment structure. So the comments that follow are related to research scientists who wish to continue working in the university.

The existence of a career structure for research scientists which is parallel to the academic staff in the universities indicates a recognition of the importance of the research scientists and allows for improvements in the career structure. However, the differences between the status of research and permanent staff do not reflect the existence of such a parallel career structure. A few examples follow to indicate these differences.

Current financial pressures make the financial contributions from research grants and contracts to the departmental budgets more significant than in the past and the work of the research scientists more important. However, research scientists are treated as dispensable at the end of their short-term contract employment, although their research generates funds much larger than their salaries, allowing the university to pay permanent academic or administration staff.

The research staff cannot participate in the decision making process of the department and influence the allocation of funds and arrangement of teaching duties, while their financial contribution and teaching duties may be similar to those of the permanent staff.

Research scientists cannot sign and negotiate contracts with the industry, although they have more experience on the subject and are those who do the work, in contrast to the permanent academic staff.

So the status of the research staff must become equal to that of permanent staff to improve the self esteem of the researchers.

Short-term contract employment is advantageous for graduate scientists, because it gives them the opportunity to remain in the university for a short period of time and acquire research experience before joining the industry. Besides, short term contracts allow for changes of the subject of research of individual researchers, which broadens their experience and improves their chances for future employment in the industry. So short-term contracts are useful for researchers intending to join the industry and can allow experience on a wide range of subjects.

The disadvantages of the short-term employment are mainly affecting those remaining in the university over a long period, because they have no job security and, if for any reason the research funding is suddenly stopped, they do not have an immediate alternative. This insecurity drives the pressure to find financial support for the researcher and leads in accepting contract research, which does not improve the career prospects of either the researcher or his supervisor.

The unlimited period of time that a researcher can remain in the university with short-term contracts may be advantageous up to an age, which allows him to find alternative employment. However, longer employment in the university on short-term contracts, either because his salary offer was attractive or because he was optimistic about his career prospects, may make him unemployable by the industry, while the university cannot offer him any permanent position.

Ways to improve career structure

(i) Set a time limit of six to eight years for which a researcher can be employed in a university on short-term contract employment, without any commitment by his department to offer him a permanent position. After this period he will have to look for a permanent job in a different university or in the industry. This will reduce the insecurity of the employment and limit the possibility of the researcher becoming unemployable. Besides, the possibility of exploitation of researchers by the permanent academic staff will be reduced. The German system is a good example of the influence of such a time limit on the development of better employment prospects and better mobility between industry and university.

(ii) Establish a career review procedure, similar to that of the permanent academic staff, which should evaluate the career development of the researcher, identify his weaknesses and set short-term targets. This review should be done by a body independent of the direct supervisor of the researcher to ensure fair judgment.

(iii) Increase the involvement of research scientists in the negotiations of contracts and grant them the right of signature on a contract. If it is legally impossible for a non-permanent member of staff to sign a contract by himself alone, then he should be able to sign the contract together with a permanent member of staff. This will improve the links between academic researchers and industry, increase their chances of employment in the industry and limit the chances of exploitation by the academic permanent staff. Again the German system is a good example of the benefits of direct contact between university researchers and industry.

(iv) Ensure active participation of the research staff in departmental meetings and decisions. This will improve the self esteem of the researchers and make them feel that they are a part of the university environment and not just someone locked away in a research laboratory without any influence on the functioning of the department. The Japanese industry is a clear example of the strong links between high standards of work and active participation in the decision making process.

Expectations for changes over the next decade

It is difficult to justify the reasons why a graduate scientist will follow a research career with low salary, low job security and bad prospects, while his qualifications allow employment by the financial sector with better working conditions. So if the status of the job is not improved, a smaller number of graduate students with good qualifications will be willing to follow a research career.

The future existence of a career structure for research scientists in the universities can be maintained only by the provision of funds from the research councils for more long-term fellowships, which will reassure the community of the importance of research scientists and improve their status. This is very important, if charismatic students will be willing to enter the university environment. Assuming that no additional funds will become available in the future, and taking into account the increase in the number of universities by the addition of the old polytechnics, the only way that the research councils can increase the number of fellowships is by reducing the funding of research in universities without good research record. The funding then should mainly target universities with past performance on research and contacts with the industry. This will ensure that a charismatic researcher will work in an environment, which has enough resources to allow high quality scientific research and links with the industry. Such research can attract the industry, since it can lead to ideas of designing competitive products or more efficient processes.

The current direction of the research councils to encourage links with the industry is correct and should be further encouraged. However, there should still remain an opportunity for basic "blue skies" research, which cannot be applied immediately to an industrial process, but which may have a future potential. Such research is important, if new ideas are going to be developed and charismatic researchers to be attracted.

Destinations of scientists leaving contract research

According to my experience over the last 10 years as a researcher in an engineering environment, the researchers can be divided in four groups according to their destination after leaving contract research.

(i) Those who join the permanent staff of universities in the UK. This number is small and is decreasing due to the reduction in the funding. It is important to keep experienced researchers as permanent staff in universities, because they would be educating a new generation of graduate scientists. Teaching staff without research background is remote from industrial problems and cannot train properly graduates for work in the industry. It should be noted that the good reputation of a university is usually determined by the high quality of research and not by the quality of teaching. High quality of teaching alone will not attract students with good qualifications.

(ii) Those who join the industry. A lot of these researchers after a period of time return for a management course in the university. Few researchers are used by the industry according to their research background. However, the last 10 years have been characterised by a recession and wide privatisation of industries, which led to large reductions of the industrial research departments, reallocations of young research staff to different departments and redundancies of senior research staff.

(iii) Those who join the financial services. It appears that all the researchers who joined the financial market have done well and are established in their jobs. It is useful that researchers continue to join the financial sector, because their research and industrial experience may influence the short-term attitude of the financial markets towards industry and research in the UK.

(iv) Those who are coming from overseas and return to their countries, where they join the industry or the university. Overseas researchers with positive opinion about the research environment in UK will take favourable decisions either in buying products produced or services offered by the UK. A few of those, including myself, decide to remain in this country and contribute their knowledge and experience in teaching and researching. The number of overseas researchers choosing to extend their experience by coming to the UK, can remain large only by ensuring that universities with high quality of research exist.

Improvement of mobility of scientists between academia and industry

An initial step towards better links between universities and industry should come from the research councils. The research councils should organise meetings on particular subjects, where industries and university researchers will be invited to participate. The purpose of these meetings would be to establish common research topics between universities and industry and encourage universities to apply for research funded by the councils and linked with an industry. The industry should have the obligation of partly supporting the research after an initial trial period, during which the co-operation between university and industry will be established. The industry could support financially a researcher, probably as a part of a Ph.D. degree, who should be willing to work in the industry at the end of the project. However, this can only be the beginning, because the attitude of the industry towards research must change, which can happen through good links between academia and industry.

The industry is the biggest obstacle in the links between academia and industry. No research scientist will decide to join an industrial research laboratory, knowing that the first financial problem leads to a cut of the research budget and reduction of the research staff. A good example of commitment in research is the approach of the Japanese industry, and in particular of the automotive industry HONDA, which is one of our sponsors, where the salary of managers is reduced by a larger amount than the salary of researchers during periods of recession to allow for research to continue. In contrast, managers in the UK award large salary increases to themselves, while they cut the research funds or make the research staff redundant. The industry must have a long-term policy in their research and development program and the financial markets should judge the performance of the industry on the basis of reports over a long period of time to allow time for an investment in research to pay its dividend. For example, the German financial market operates on the basis of reports over a five year period and not over six months and the research effort of the German industry is larger and the links with the university are more established than in the UK. No research project can provide a significant result in a period of six months. The universities can help in these long-term plans of the industry by providing research, which compliments that of industrial laboratories, and the improvement of mobility of the researchers from the university to the industry will happen following such research projects.

Women in science and technology

There has been an increase in the involvement of women in science and engineering courses over the last 10 years. The same trend will continue over the next decade. However, the short-term contract employment of scientific researchers is not attractive for women, since it does not offer maternity leave. Change of the employment rights to provide for maternity leave will generate two problems:

(i) increase of the cost of the research;

(ii) requirement for employment of temporary research staff for a three or six month period. It is very difficult to find a scientist with experience on a particular subject, who will be willing to work for such a short-term contract. Besides, the training period may be of the order of three months or more.

So, in practice, the employment of women on short-term contracts will be avoided in cases where this could be justified, even though there is provision for maternity leave.

Women involvement in university contract research can only increase by offering more long-term contracts. In this way, maternity leave over periods of three months can be arranged by stopping the research for this period without replacing the main researcher by temporary staff and without increasing the cost of research. Of course, this will mean more commitment by the main researcher during the remaining period of the contract to cover for the time lost.

Evidence from the Higher Education Funding Council for England

Differences Between HEFCE's and SHEFC's Funding Formulae for Higher Education

Your letter of 28 April refers. After making enquiries with my colleagues in the Council, I am under the impression that your interest lies mainly with the formula for the funding of research and therefore have only included the research element of funding in my response.

In general, the HEFCE's main funding formula for reserarch is based on a fixed amount of money for each of 72 subject categories (called Units of Assessment). The amounts of money for each Unit of Assessment is based on historic levels of funding, but there have been movements of money between subjects resulting from a decision to moderate outlying rates of funding in certain subject areas. (These outliers were a result of the meger of the UFC and PCFC-funded sectors and also the transfer of funds to the Research Councils.)

Once the amounts for each Unit of Assessment are determined, the funds are distributed to participating institutions in proportion to the volume of research and a variant of the quality rating they received in the 1992 Research Assessment Exercise.

I have attached a table outlining the main differences between the treatment of the various parameters in the research model by HEFCE and SHEFC. (The moderation of outliers has been referred to in the tables as the migration strategy.)

Please contact me if you require further details or clarification of any of the information I have given you.

A Comparison of HEFCE and SHEFC Research Funding Practice Methods for 1995–96 Allocations

		SHEFC	*HEFCE*
	Components of Research Funding	— Principal Funding Formula (£96m, 95%) — Income-based Funding-DevR (£5m, 5%)	— Quality-related Funding (£600m, 94%) — DevR (development funding) (£16m, 3%) — Generic Research (£20m, 3%)
	Determination of Totals Available for 1995–96	— Principal Funding for 1994–95 uprated by inflation (3.25%) and subjected to efficiency gain of 1% — Income based funding for 1994–95 uprated by inflation	— Research Allocation total for 1994–95 uprated by inflation (3.25%) and subjected to a 1.6% efficiency gain
Quality Driven Component (Principal Funding and QR Funding)	Allocation of Money Within Subjects	Weightings for Volume Components — Research active academic staff funded from general and other funds: 1	Weightings for Volume Components — Research active academic staff funded from general funds:1
	Both Councils allocate money to institutions within subjects in proportion to the product of their (transformed) rating and volume measure	— Research Assistants: 0.1 — Research Students: 0.1 — All external research income (charities, research councils, industry etc.): 0.000004	— Research Assistants: 0.1 — Research Students: 0.15 — Income from charities: 0.000008
		Rating Transformations — Q-1 if Q = 1, 2 1.4 if Q = 3 1.96 if Q = 4 2.744 if Q = 5 (i.e. 40% uplift)	Rating Transformations — Q-1 for Q = 1,2,3,4,5
		Basic and Applied Ratings Weighted average of basic and applied rating used in allocations	Basic and Applied Ratings Funding for applied research limited to 20%
	Allocation of Money to Subjects for 1993–94	On basis of UFC allocations with additions for merger of non-UFC sector	On basis of UFC allocations with additions for merger of non-UFC sector
	Migration Strategy for the Allocation of Money to Subjects 1994–95	Units of assessment assigned to three broad subject bands with associated cost factors. Allocations based on 50% of 1993–94 allocation and 50% on V*C*Q*P, where V is the number of research active academic staff, C is the Cost Factor and Q is a function of quality. P is currently domant.	Units of assessment (UoA) classed into four broad cognate areas or "families" (one being Education alone). Units of Resource for each UoA to be brought to within +/−20% of the family average over three years, 1994–95 being the first year. Money for subject to be proportional to V*U where V is the research volume measure and U is the adjusted Unit of Resource.
	Migration Strategy for the Allocation of Money to Subjects 1995–96	As with 1994–95 but with 75% weighting given to the new method.	Slight change in 1994–95 strategy implying that Units of Resource be brought to within +/−15% of the family average over the two years.
	Capping	No capping process	Cap for institutions in 1995–96 set at 15% for the quality-related component of research funding.

	SHEFC	*HEFCE*
Funding for the Development of Research	Based on all external research income of all departments rated 2 or below (including those which did not participate in the 1992 RAE). Funds released on submission of acceptable institutional strategy for use.	Available for former PCFC-funded institutions and the Wimbledon School of Art only. Funds are allocated in proportion to the number of research active staff in departments rated 2 and above in the 1992 RAE. Funds released only on submission of acceptable strategy for use.
Funding of Generic Research	No explicit funding for generic research. It is considered to be taken into account in the volume measure of the principal formula.	Distributed on the basis of the value of grants/contracts for research of a collaborative nature, moderated by an overhead recovery rate.

Comparison of Degree of Selectivity between SHEFC and HEFCE Resulting from Transformation of RAE Ratings in Allocation Model

(1) Table showing degree of selectivity in SHEFC's principal funding model

Q Rating for Institution i

		1	2	3	4	5
Q Rating for Institution j	1	–	–	–	–	–
	2	–	1	1.4	1.96	2.744
	3	–	–	1	1.4	1.96
	4	–	–	–	1	1.4
	5	–	–	–	–	1

eg Institution i with rating 3 receives 1.4 times as much as institution j with rating 2, institution i with rating 4 receives 1.96 times as much as institution j with rating 2, etc.

(2) Table showing degree of selectivity in HEFCE's principal funding model

Q Rating for Institution i

		1	2	3	4	5
Q Rating for Institution j	1	–	–	–	–	–
	2	–	1	2	3	4
	3	–	–	1	1.5	2
	4	–	–	–	1	1.33
	5	–	–	–	–	1

eg Institution i with rating 3 receives twice as much as institution j with rating 2, institution i with rating 4 receives three times as much as institution j with rating 2, etc.

CONCLUSION

The pairwise comparisons show that HEFCE is more selective in its quality-related funding model than SHEFC in all cases except between a 5-rated institution and a 4-rated institution. Even in this case, the difference is small, with SHEFC allocating a 5-rated institution 1.4 times as much as a 4-rated institution, whilst HEFCE allocate 1.33 times as much funding to a 5-rated institution than to a 4-rated one.

Professor Graeme Davies
Chief Executive.
4 May 1995.

Evidence from the Higher Education Funding Council for Wales

Thank you for your letter of 16 December 1994 inviting evidence to the Sub-Committee. It is, of course, the Universities and Colleges who are really close to the issues raised by the sub-committee and who will, in consequence, be able to offer the most pertinent comment. Nevertheless, there are a number of observations I can make on the basis of the Council's work in the Welsh HE Sector. I hope these may be of help.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

2. *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

These questions seem to me to be interrelated. It is unquestionably the case that constrained public funding is disposing institutions increasingly to short, fixed term contracts in order to maintain flexibility in their most expensive area—staff. There are some advantages in the short, fixed term contract, for example, those who find themselves, or are found, unsuited to academic research may move out reasonably quickly; institutions can retain flexibility to adjust and develop their staffing to reflect changes in their research thrusts. When short term contracts become the norm, however, there are significant disadvantages. From the point of view of researchers, there is the distracting uncertainty about career propects in the longer term; from the point of view of research managers there may be wariness about embarking upon research of a long term nature. It may not be possible to maintain research teams and long term research may tend to be carried out in a fragmented manner or foregone in favour of more modest programmes.

3. *How do you expect the situation to change in the next decade?*

Institutions will have to confront a difficult situation. They will need to maintain flexibility in relation to staffing structures and budgets; at the same time they will need to provide for continuity in the staff base. Institutions will be required to take a far more strategic approach to staffing issues to balance the considerations of flexibility and continuity. The more prudent have begun now by seeking to make any new full-time appointments in the mid twenties to thirties age range.

4. *What information do you have concerning the destinations of those scientists between academic and industry?*

I have no information on this question. Over time, the Higher Education Statistical Agency, which has come into operation this session, will be able to provide details on the basis of returns from institutions.

5. *What should be done to improve the mobility of scientists between academe and industry?*

Current collaborative schemes supported by Government, the Research Councils and Industry are considered to work reasonably well. They might be modified to allow the possibility of mobility. However, this is an area where the influence of the academic culture has to be recognised. In general, higher education will look to a publications record rather than a period of updating or refreshment in industry when making decisions about promotions. A change in prevailing culture would be likely to stimulate mobility to a far greater extent than new or modified special schemes.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade. What should be done to make scientific careers more attractive to women and how?*

I understand that the position on recruitment of women has improved in recent years although it remains difficult and is expected to continue that way for the foreseeable future. Part of the problem appears to be the unattractive image of the disciplines to some women and the notion—and current reality—of their being male dominated. One institution in the Welsh HE Sector has made some headway in relation to recruitment by broadening the base of its engineering provision to include, for example, architectural and environmental engineering. These applications have proved attractive to women who apply to and join the courses in encouraging numbers. This, coupled with a greater number of women staff, is helping to attract more women in to the traditional as well as the new engineering courses.

7. *What is your assessment of the worth of the new MRes degree?*

The objectives of broadening the base and improving the quality of postgraduate study seem entirely valid but I share the scepticism which some commentators have expressed. A number of institutions would claim already to be meeting the objectives through the programme of supporting studies they provide for their PhD students. They would take the view that there are more effective means to an end than the MRes and I suspect too that few students outside of those supported by the Research Councils will wish to follow the MRes route.

Professor John Andrews
Chief Executive

19 January 1995

Evidence from ICI Chemicals and Polymers Ltd, Research and Technology Department

Introduction

The following submission deals with the question of academic careers for graduate scientists, from the perspective of a large chemical company. This question is of significance to the chemical industry which relies heavily on academia in two main respects. First it is a source of supply of trained professional manpower, skilled and knowledgeable in the physical sciences and engineering, as well as having independence and flexibility of mind to meet the challenges of competition in the global market place. Second academia provides a considerable and continuously growing amount of underpinning science, from which future technology developments are made.

In general the quality of the top graduates and postgraduates available appears as good as, it has ever been, although in the middle ranks there is some concern. However some decline in the state of the underpinning chemical sciences in the UK is clearly apparent.

Based on our perspective we have concentrated on question (1), (2), (5) and (6), but have responded within a fuller context of our perception of academic careers.

The Start and Finish of Academic Careers

Our first observation on academic careers concerns their beginning and end. We perceive that high retirement ages block entry, and that entry, when it occurs, is a haphazard process. If retirement were fixed at a more reasonable age, and the system of Emeritus appointment more widely used, to retain those whose scholarship remains an asset, then in the short term at least, some more career movement could take place.

The entry process to an academic science career appears to involve selection from a pool of young doctorates who have completed their formal training, and are working on fellowships and contracts. This pool is large, with dwell times, apparently, often in excess of eight or more years. Not surprisingly, for a group who rely on regular renewal of contracts, often yearly, morale can be low, with much non-productive energy devoted to securing the next position.

These individuals also often seem to be used as hired hands by the principal researchers who direct their work, with little thought being given to their personal and professional development. Thus many will spend over five years in a developmental limbo before either giving up and seeking an alternative career or being selected and drawn into the ranks of fully employed academic staff.

However, this pool does provide flexibility as projects start and finish, and it also acts as a useful proving ground for future academic staff, who can gain a track record.

We believe that this system could be improved. A welcome start might be the Universities taking greater responsibility for managing this activity, in a way that develops individuals for the appropriate junior posts, and quickly weeds out those who are not going to be contenders. For the Universities to exercise greater responsibility for this activity, they would need financial control, coupled with a clear Departmental strategy, which included appropriate staff succession plans.

The entry and re-entry of women into academic careers also warrants some attention. It is perceived that they are not well represented in the physical sciences and engineering. One issue concerns breaks for maternity and family duties. Since academic careers are significantly based on reputation, a loss of several years places those wishing to re-enter at a disadvantage. One solution might be imaginative schemes involving contractual fellowships, designed to restore reputation and track record, as a bridge back into a mainstream academic career.

The Academic Career—Teaching or Research

It has been apparent for some time that University Departments need to take a more distinctive view of their two basic functions, namely teaching and research. In many establishments these two activities are blurred together with excellent researchers who are indifferent teachers, alongside indifferent researchers who are excellent teachers. On the macroscale, a recent survey by the Association of Graduate Recruiters showed that whilst both excellencies occur in some Universities, there are many where only one or other is present.

It seems inevitable that the national desire to expand University education and the limitations on the public purse, must lead to selectivity, where some Departments will maintain and foster excellence in research, and others concentrate on teaching more students.

Such a selection is to be welcomed as it should permit greater exploration, and development of mass tertiary education and teaching, using the rapidly developing communication and information technologies. For those Departments who will also do research it should facilitate concentration of resources in many of the areas identified, by the Foresight programme, as being of national importance. It should also foster excellence, to ensure a steady stream of highly trained individuals available to the nationally important wealth creating industries, such as the Chemical Industry.

Selectivity will also throw into greater relief, the issue of whether an academic career should be in teaching, research or a combination of both. Observation suggests that junior academic appointments and indeed subsequent academic advancement, do not pay enough attention to this. There are many examples of high quality researchers who find it difficult to teach and excellent academic teachers who find advancement difficult because their research capabilities are not high enough.

A further issue is the relative lack of training and development for Academic staff. It is perceived that very few academic staff receive any training in teaching skills, or indeed in the supervision of research. Furthermore the provision of personal development training and experience is often also neglected. This is surprising to those responsible for industrial research establishments, where continued training and personal development are pursued throughout an individual's career. Leadership and management skills are also often not developed significantly, with the effect that research leadership and Departmental management are sometimes lacking.

These views reinforce the arguments for selectivity and suggest that much greater formality and planning should be introduced into the selection and advancement of academic staff. Within this increased formality, considerably more training and development of the appropriate type should be provided, with regular individual review.

Academic Departmental Management

The foregoing recruitment and career development discussion suggests the need for a higher level of organisation and management than is often found in University Departments. The historic University structure and ethics, based on the worthy notion of academic freedom, has bequeathed loose and often weak management structures within many of our Universities. This is less true in the newer Universities which have gown out of the more recent Polytechnic and Technical College structure.

It is our belief that ways must be found to increase leadership and management within University Departments, without sacrificing all of the valued freedoms of scholarship. Our belief centres on the perceived need to define more clearly the objectives and strategies of Departments, particularly with respect to teaching and research. Their research objectives will also need some linkage to Government finance through the Research Councils, and to industrial sponsors.

Alongside these objectives clearer standards of performance and output will need to be set, together with strategies for the recruitment, training and development of their key asset, the academic staff.

If some of these improvements in the management of academic Departments could be achieved, then this should pave the way for more strategic alliances with industrial companies. We believe that such strategic alliances could be extremely beneficial. They would foster relevant underpinning science in the University and provide for staff exchanges to enrich University teaching and research, and the industrial company's knowledge and skill bases. The exchange of academic staff to industry would also provide both training and development opportunities for them. Alliances of this type would provide a great deal of mutual benefit, as well as strengthening our national competitiveness.

Summary

In summary, we believe that there are many improvements and reforms, which could benefit academic careers for graduate scientists. At the same time these improvements and reforms could significantly improve the quality and quantity of our national graduate output, and help focus and further harness our limited national research resources towards helping our wealth creating industries to maintain their competitiveness.

J Beacham

10 January 1995

Evidence from the Institute of Psychiatry

Career Structures

1. It is in the long term interest of both funding bodies and employing institutions to ensure that the career prospects of highly skilled and experienced scientists are not threatened by constant pressure to cut costs, and that adequate career structures are developed.

In this respect, the MRC has done rather more than others and may provide some helpful ideas. In the past, there has been a problem in moving from short-term positions to career scientist posts but there is now an intermediate tier, in MRC research units, that helps with that transition. There have also been appropriate developments with respect to research positions outside units. The planned new pay structure for the MRC will aim to ease the transfer of staff between the MRC and the universities, between MRC and the National Health Service, and vice versa. The Scientific Officer grades also provide opportunities for that very important group of people who are not themselves going to be team leaders or innovative, creative scientists but who provide skilled expertise in the middle range of research. Because these are positions without time limit, they provide reasonable career security. The Department of Health research units are in some respects comparable but they provide much less security. The main problem with the system is that, inevitably, there are far more scientists outside MRC units than there are in them. That has very considerable advantages but it does have the disadvantages of short term appointments and a lack of career structure for those who are not going to go on to become research leaders. This is particularly so with those whose research skills are in areas that do not exactly coincide with teaching needs, and hence may not be able to obtain core university posts.

Growth in the Number of Short-Term Contracts

2. The growth in the number of short-term contracts has some advantages in terms of the amount and potential flexibility of research in universities, but has many disadvantages for both the research and research workers. So far as the latter is concerned, lack of career prospects is an obvious disadvantage. As for the former, it does not take into account the need for continuity in research expertise and in the development of new methodologies. Short-term contracts also encourage "safe" science with a predictable outcome, at the expense of potentially more profitable but also more risky scientific programmes. It is hard to provide for the required continuity and long-term strategy of fundamental research on the basis of short-term contracts. The use of short-term contracts with tight financial budgets can also put older research workers and, in particular, women scientists, at a disadvantage.

A further disadvantage is the problem of financial bridging of staff between research contracts. This can cause considerable problems for institutions where funds are limited and demand for support can be high, especially where the staff are productive and need to be retained.

Changes in the Next Decade

3. It is likely that the current age structure of academic staff will have considerable implications over the next decade with the loss of many experienced researchers. Further long-term financial support for good young researchers would help to balance the age distribution over this period and would provide a pool of research talent from which future research leaders could be drawn.

Careers for women in science

4. The main problems for women in science are those of a logistic nature, arising from combining family commitments and a scientific career. The problems are particularly acute for clinical scientists since they also hold an honorary clinical appointment in addition to their research post. There is a need for more flexible working arrangements such as part-time posts and job-sharing. It should also be acknowledged that the rate of career development in women (ie the age at which they are expected to be appointed to various academic posts, or the age at promotion) might be different to that in men. There should be no age limit for applicants for research or academic posts, or for promotion, since these discriminate against women who either have taken time out of their career to have a family or have worked as part-time scientists at the same time as being responsible for young children.

Inevitably, women who have children will need to take maternity leave. It is clear that a researcher's career, particularly that of a short-term contract worker, should not suffer as a result of this. It is also important that the research project should not be jeopardised. There is a need for the employing institutions and the funding bodies to explore ways in which extra funding might be provided to allow for the employment of temporary staff to ensure the continuity of research during a period of maternity leave and/or the extension of a project to allow for its successful completion.

January 1995

Evidence from the Institute of Civil Engineers

1. The main problem concerning the present career structure for academic scientists is in fact the absence of any clear career path available to those finishing their doctorates. This is compounded by the perception among graduates that there is no real career advantage to be obtained in taking a postgraduate course, as the construction sector at least, values experience more than higher academic qualifications. This situation is not repeated among our competitors in Europe, where science and engineering graduates and postgraduates are well represented among senior management, placing the UK in a disadvantageous position.

There is, therefore, a fundamental problem in attracting the best UK students into research and thus preparing them for special posts in industry or as future university lecturers. This was demonstrated by a survey of all university civil engineering departments, carried out by the Institution, which showed clearly that over a 16 year period the number of UK postgraduate students had dropped from 275 to 200, while the number from overseas increased from 200 to over 500. A copy of this survey report is enclosed.

The problem stems chiefly from the low level of research awards in relation to salaries in industry and commerce, and also from the lack of a secure or predictable career path afterwards. Consequently, there is a dearth of applications to advertised posts, leading to a waste of resources as research staff have to seek alternative employment because of the lack of senior posts.

2. The essential problem with short term research contracts in academic science is defined in the title—short termism. Universities have traditionally been the centres for longterm and fundamental research, which is not undertaken by industry. The danger with short term contracts, therefore, is that they will undermine the longterm research objectives of the institutions concerned and focus instead on short term problem solving. With the progressive decline of our manufacturing base, there is a danger of a parallel decline in the UK's research base as well.

For example, among established, non-university research bodies such as HR Wallingford, the proportion of basic research being undertaken has reduced dramatically and longterm research is now difficult to sustain. The future of BRE and TRL, both of which have international status, is similarly threatened.

3. From the Institution's survey referred to above, it is clear that with the present age distribution of staff with doctorates in universities and research establishments, there will be significant losses in numbers in the next ten years.

4. In that survey, Heads of Departments estimated that only about 15 per cent of their postgraduate students were likely to seek academic careers. Given the factors referred to in (1) above, this figure is not likely to rise.

5. A great deal could be done could be done to improve the mobility of scientists between academia and industry. Much could be learned from other parts of Europe where it is natural for working professionals to spend one day a week teaching. The benefit is mutual; industry rubs shoulders with education and brings developments back into work, whilst academics are freed of some teaching to concentrate on research, assisted by industry. We believe government should encourage such "worker teachers" and also expand the Teaching Company Schemes, particularly in the construction industry where they have not been developed as far as in other industry sectors.

This needs to be matched to an adequate recognition by the HEFCE in its Research Assessment Exercises, of the value of TCS's which are an excellent mode of dissemination of research results, since research undertaken but which is not disseminated is research wasted.

Another measure of the problem is the low takeup by industry of the Engineers to Europe scheme.

6. We expect a greater proportion of women to enter engineering in the next decade. One possible indicator of this is the fact that in the past year we have for the first time awarded more Queen's Jubilee (QUEST) undergraduate Scholarships to women (19) than men (15). This trend is likely to be repeated again this year.

The area where most women are joining the engineering profession is in environmental engineering. Several universities have begun Civil and Environmental Engineering degrees and the proportion of women joining these courses is much higher than for straight engineering courses.

Civil engineering is vital to environmental improvement and the quality of life, but this is unfortunately not the perception of the public at large (who take for granted water supply, waste treatment and disposal, roads, bridges, tunnels etc), although the renaming of courses and changes in their content is convincing students that engineering is vital to the environment as well as being interesting. Such aspects should be emphasised to encourage women to make scientific careers.

7. We have no objection in principle to the MRes degree, but at present there are very limited funds available to assist students to read for a Masters degree. It is important that it should not be seen by the funding agencies as a cheaper alternative to a doctorate, but its ultimate worth will depend to a large extent on its acceptance by employers as an adequate research qualification.

The MRes should place emphasis on project management training to enable students not only to do research themselves, but to do it in a cost effective manner and in later life, to be able to manage research teams.

Evidence from Dr E A Johnson, Daphne Jackson Memorial Fellowship Trust, Department of Physics, University of Surrey

EXECUTIVE SUMMARY

I. Current career structures for contract researchers in UK universities:

I.1 Contract research work is normal and important at the start of an academic career, providing experience in research (and some lecturing), plus some degree of freedom.

I.2 There are a considerable number of longer-term (mature) contract researchers, of whom a disproportionate number are women.

I.3 Some Research Councils discourage funding for experienced researchers, and operate policies which make promotion of experienced research staff difficult if not impossible. Some Research Council funding decisions have resulted in de facto demotion of experienced research staff.

I.4 Research staff are often not informed of their rights to dismissal and redundancy provisions. Some positive measures may have negative side effects.

I.5 Uncertainty and instability for experienced researchers makes conduct of good research difficult.

II. Women returners often become contract researchers, even those with previous industrial experience. Flexibility and the choice of working part-time may be important factors.

III. A disproportionate number of mature, long-term contract research staff are women. Mobility to industry might result from more flexible working arrangements.

IV. The MRes may give good training in specific subjects. If operated part time it might help returners to science, and students on part-leave from industry.

V. Positive changes might result from well-thought out codes of practice for Research Councils, from changes in the university Dual Support funding, and from amendment of the formula for the HEFCE Unit of Resource. Care should be taken to avoid negative side-effects.

I. PROBLEMS AND ADVANTAGES OF THE CURRENT CAREER STRUCTURES FOR ACADEMIC RESEARCH WORKERS IN THE UK:

Academic research workers are usually funded by short-term grants or contracts (both models of funding will usually be called "contracts" herein). These will be of two or three years' duration, though some will be shorter. There is a little evidence of a career structure as such for academic research scientists employed on series of short-term (−3 year) grants or contracts in the UK.

I.1 *Contract research work at the start of an academic career:*

(a) Employment on a research contract is a normal and important part of the training of a good research scientist who may want to make this a long-term career, and who has just finished a PhD. The research undertaken may help to bring to fruition promising lines of research which opened up during thesis work. This is also a time in which young researchers begin to take responsibility for choosing their own research direction, and for establishing their own independent academic contracts.

(b) A research contract can allow a researcher the freedom to concentrate on the research problem on hand without the many administrative and teaching commitments that form a normal part of a long-term academic's commitments. It also allows young researchers the time and opportunity to discover their aptitude for an academic and/or research career.

(c) Lecturing or tutorial experience if often gained by researchers during their time employed on a research contract. Provided the commitment of time is strictly limited, this can provide excellent experience for a future career as a university staff member.

(d) Most of the advantages of contract research to a young scientist have to do with equipping such a person for a long-term career in academia. One might question whether young researchers should be encouraged strongly in this direction, given the great scarcity of standard career positions in academia (Lecturer, Senior Lecturer, Reader, Professor).

I.2 *Contract research work in the longer term:*

A recent study of 400 contract research staff by the Association of University Teachers [1] has found that

(a) One-third of their sample were long-term researchers (ie had worked on three or more research contracts).

(b) 57 per cent of their sample were aged 30 or older.

(c) 55 per cent of those aged 40–49 were women.

(d) There was little evidence of a career structure or career development for these academic researchers.

(e) Over 50 per cent of contracts were for two years or less. Only 33 per cent of contracts were for three years, only 8 per cent were longer than this:

(f) Nearly half the sample had teaching duties; 74 per cent of these were not paid for this teaching. More than 50 per cent were involved officially or unofficially in research student supervision.

(g) Promotion is difficult for contract research staff.

(h) Contract research staff can be forced to take salary cuts in order to gain a new contract.

I.3. *Promotion*

The "Recommendations on Codes of Practice for the employment of Research Staff on fixed term contracts" published by the Committee of Vice-Chancellors and Principals (CVCP) and the Association of University Teachers (AUT) in 1990 [2], recommends that contract researchers employed on successive contracts should advance up the relevant salary scale in the same manner as other university staff. This document states that "The research funding agencies wish to ensure that staff funded by them are treated no less favourably than permanent staff and accordingly will normally provide funding to meet the costs involved. This means that, like permanent staff, research staff are entitled to apply for and be considered for promotion, advancement and discretionary payments." My personal experience indicates that there are several points to make in this respect:

(a) While universities appear to have been scrupulous about advancing researchers through the appropriate salary scales on a given contract, they have at times appeared powerless in the face of a decision by a Research Council, in funding a named researcher on a new contract, to fund the post at the minimum point on the scale. The AUT's survey [1] of contract research staff suggests that this occurs with some frequency.

(b) Even if a university has the express policy of considering researchers for promotion based on merit, it appears to be common knowledge that many Research Councils prior to the recent Research Council reorganisation have refused to consider additional funding to meet any costs associated with such promotions, so that researchers supported by those Research Councils would be routinely advised that there was no point in applying for such promotions. I understand that the Medical Research Council has been an honourable exception to the general rule.

(c) At least some Research Councils have applied a blanket rule that there should be a maximum length of time named researchers to be funded on research grants. To say that this can penalise good and experienced scientists for the benefit of young researchers at the start of their careers is to misrepresent the situation, since the young researchers on the whole will either not enter academia at all or else will be likely to become older contract researchers themselves in a similarly parlous situation.

I.4. *Dismissal and Redundancy Provision:*

It is not yet common practice for universities to advise their contract research staff on the dismissal and redundancy provisions to which they are entitled by law, and many researchers are unaware that they have any such rights [1].

On the other hand, at least one institution (Imperial College of Science, Technology and Medicine) has recently decided to award an improved package of rights to all contract research workers with more than a stated minimum period of service. This attention to the improvement of the career position of its contract researchers on the part of Imperial College is to be applauded. Nevertheless such improvements may have unforeseen side effects. One result of this particular kind of decision is known to be that institutions faced with additional financial commitments to employees who fulfil a minimum term of contract is that the institition (particularly if hard-pressed for funds) simply ensures that no such employee is ever employed to the completion of the minimum term, thus creating de facto discrimination against experienced researchers similar to that in operation in at least some Research Councils (see part I.1.(c), above).

I.5. *Wastage:*

From the point of view of a contract research worker who aspires to carry out a programme of research in a largely self-directed fashion, to set research directions and to inspire others with a research vision, the role of contract researcher can be a grave handicap. It is noteworthy that so much good research is done in British universities by such people, given the inbuilt liabilities inherent in their situation. These include

(a) the fact that persons involved in research naturally funded by the Research Councils are unable to submit and be responsible for grant applications in their own right;

(b) the fact that because of the uncertainty of their own funding situation they often consider it morally inadvisable to attract research students of their own, since in the event the researcher's funds failed, the student would suffer the loss of a supervisor, at considerable disadvantage in progress towards a PhD; and

(c) since "In scientific disciplines, access to graduate students, facilities, and research funds are probably the most important factors in terms of productivity" [3], contract researchers are penalised from the start in precisely those areas which are the most important in terms of the research productivity by which they are supposedly characterised. The high quality of much of the contract research done in Britain is particularly noteworthy given this fact. The AUT also concludes from its survey of contract researchers that "quality research is produced despite the system rather than with the support of the system."[1]

II. Destinations of those leaving the university contract research sector; mobility of scientists between academia and industry:

II.1 The Daphne Jackson Trust [4] has gathered statistics on former Daphne Jackson Fellows appointed during the pilot project phase of the fellowship scheme [5]. Approximately 30 per cent of all fellows for whom statistics were available in 1993 had gone into short term contract research in UK universities, and 20 per cent had accepted Lectureships, some of which were also short-term. Although some 40 per cent of the Fellows had some industrial experiences before their career break, only 19 per cent found their way back to industry upon completion of their fellowship.

One may speculate that for women with family commitments, it is easier to reconcile those commitments with a life in science in the academic sector than in industry.

II.2 Because of the poor career prospects within academia at the present time, the Daphne Jackson Trust [4] for returners to science and engineering encourages all applicants to choose research projects which may open career prospects outside of academia, and to be active in looking for employment in industry, as well as academia, once the fellowship term has ended.

III. Women in science and engineering; Women in the contract research sector

III.1 The problems inherent in trying to make a long term career as a university researcher have a particular impact on women. A recent study of 400 contract researchers [1] found that 40 per cent of the contract researchers studied were women. This should be contrasted with the relative scarcity of women academic staff members, especially in science and engineering. In one technological university (Surrey), women made up 33 per cent of academic research staff in 1994, but only 17 per cent of the total academic staff [6]. A 1992 study at the same institution [7] showed that in the "hard" sciences (Physics, Chemistry, Mathematics and Computing Science) only 5 per cent of the adademic staff members were women, but that women made up 19 per cent of the contract research workers in these subjects.

III.2 A recent study [1] found that 56 per cent of the contract reserarchers aged 40 and over in their study were women. It must be emphasised that women make up a small proportion of academic staff, especially in the sciences and engineering. One must conclude that highly trained women scientists and engineers tend to gravitate to contract research work, and that they tend to remain in this environment on a long term basis.

III.3 Contract research work may be particularly attractive to highly trained women who are simultaneously committed to a scientific career and to the care of younger children or elderly dependents. One reason seems to be the intrinsic rewards of creative scientific work to a dedicated scientist, combined with a flexibility of employment (flexible hours and relative ease of making part time arrangements) which allows this scientific role to be combined with that of care-giver. The existence of this flexibility will depend to some extent on the nature of the research to be undertaken.

Women applying for fellowships to the Daphne Jackson Memorial Fellowships Trust [4] often indicate that the part-time nature of the fellowship scheme is one of its attractions. While a number of women with family commitments make arrangements which allow them full-time employment, others actively seek part-time work as a matter of priority. These women include among their number many excellent and committed scientists and engineers.

III.4 Daphne Jackson Fellows [4], returning to a scientific or engineering career after a substantial career break because of family commitments, at first find themselves in situations analogous to those of PhD students, but usually progress rapidly to a situation more analogous to that of a part-time contract researcher. One difference of note is that retraining is a manadatory part of a Daphne Jackson Fellowship.

The Daphne Jackson Trust [4] has gathered statistics on former Daphne Jackson Fellows appointed during the pilot project phase of the fellowship scheme. Approximately 30 per cent of all fellows for whom statistics were available in 1993 had gone into short term contract research in UK universities.

III.5 As discussed in Part II, above, there is some evidence that women scientists with family commitments find the university contract research sector an environment allowing them more flexibility to meet their dual commitments. Changes in industrial working policies seem indicated, if industry wishes to make use of this considerable but grossly underused national resource.

IV. MASTER OF RESEARCH:

IV.1 Study and research leading to a Master of Research qualification would appear to offer good training in specific disciplines, and thus to give good preparation for more advanced work in those disciplines, whether in academia or industry. Industrial involvement with a given MRes programme would seem to be desirable in order for the training to lead naturally to a career in industry.

IV.2 An MRes qualification might offer adequate preparation for contract research at a fairly low grade, but not for the kind of research generally carried out at a higher level, for which a PhD is usually taken to be the correct qualification.

IV.3 If an MRes programme were arranged in such a way that it could be carried out over two years half time (rather than one year full time, as is currently suggested), then an MRes would probably be a viable route to re-entry to science or engineering after a career break, particularly for persons with ongoing family commitments. The situation would then be analogous to that embodied in a Daphne Jackson Fellowship [4] for returners to science and engineering, subject to the constraint that an MRes qualification would be limited to those subject areas in which such a course existed independently.

IV.4 Mobility between academia and industry might also be enhanced by a part-time MRes course open to people on part-leave from industry.

V. OTHER ISSUES AND SUGGESTIONS:

V.1 Changes in Research Council policy:

Changes in Research Council policy that could help provide a measure of stability and career progression to contract researchers in UK universities. It has already been noted (I.3.(b), above) that the policy common to many of the Research Councils not to provide funding for any research promotions a university might wish to make has de facto made it impossible as a rule for such promotions even to be considered. The situation may be less difficult in the case of big (rolling) grants which may fund many such researchers at any one time and in which there is some room for financial manoeuvre. Thus besides the lack of a common policy among Research Councils (I.3.(b), above) there is also a lack of equity between "big science" (group funding) and "small science" (funding of an individual reasearcher for a particular project). Modest but very positive changes could be made though a common code of good practice for the Research Councils which included modest financial provision for funding university-led promotion of researchers, and for a common policy which took into account the existence of expertise of some proportion of longer-term contract researchers.

V.2 Changes in government funding policy:

The current funding policy for research in science in British universities has several adverse effects on the situation of contract research scientists in academia.

(a) The shift in the dual support system:

Research Council grants now contain an element of 40 per cent towards overheads. It would seem that these funds should go towards supporting the research infrastructure of the institutions and the disciplines concerned, but this does not seem to have happened, for several reasons. One is that these funds are often absorbed into the overall operating costs of the institution rather than being clearly directed towards research-specific purposes. The other is that these funds were supposed to have come from the element deducted from the general research funding provided to the institution by the HFC (now the HEFCE); in practice, in many scientific and technological disciplines the result of this dual support shift was strongly negative, so that there is now less general funding for research purposes, especially in science and engineering, coming into universities than heretofore [8]. Some key areas of science and engineering have suffered a substantial net loss in research funding as a result of these changes, as the HEFCE itself is aware [8].

It would seem imperative, in order for Britiain to retain a research base, that this base should receive adequate and stable research funding. If this situation were to be the case, one might envisage univerity funds being made available to fund university-led promotion of its good contract researchers, or even a cooperative arrangement to this end between a university and the appropriate Research Council.

(b) Unit of Resource:

The current formula for HEFCE research funding to universities [9] depends on the number of persons engaged in research multiplied by a weighting factor which differs according to the category of the person in question. Research active academic staff each have a weighting of unity, while research students count only 15 per cent each towards the total. Contract researchers are at present given even less weight in this determination (10 per cent for Research Assistants, five per cent for charity-funded staff). A weighting which reflected more realistically the contribution of research staff to a university's research effort, as well as the general costs attendant on that effort, would cease to penalise a university so strongly for the research work carried out in its midst.

V.3 Danger of over-simple solutions:

Care should be taken in introducing changes aimed at improving the lot of the contract researcher, since some of these (eg making mandatory improved conditions for longer-term research employees) may have effects opposite to those intended (such as the imposition of a maximum but short length of continuous employment at that institution).

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2. Committee of Vice-Chancellors and Principals of the Universities of the United Kingdom—Association of University Teachers, "Recommendations of Codes of Practice for the employment of Research Staff on fixed term contracts" (October 1990).

3. M Osborn, "Status and Prospects of Women in Science in Europe", *Science* magazine Policy Forum, Vol 263 (11 March 1994) p1389.

4. The Daphne Jackson Memorial Fellowships Trust, Department of Physics, University of Surrey, Guildford GU2 5XH (Tel: 01483 259166): some information on the Trust is appended.

5. Ref 4, internal statistics.

6. Employment Statistics, University of Surrey Equal Opportunities Committee (1994).

7. E A Johnson, "Women in science and engineering Higher Education: some answers and their questions", invited talk, Science Policy Support Group Forum on Women in Science (March 1993).

8. Professor Graeme Davies, Chief Executive, Higher Education Funding Council for England, letter to Prof A Donnachie, Department of Physics, University of Manchester (30 June 1994): see point 5.6 on p2, the penultimate paragraph of p4, and Annexes A, B, C (*not printed*).

9. Professor Graeme Davies, Chief Executive HEFCE, "HEFCE Research Policy", talk presented at the Standing Conference of Physics Professors, Society for Chemical Industry, London (25 November 1994), point 9.

17 January 1995

WOMEN RETURNERS TO SCIENCE AND ENGINEERING: AN OPPORTUNITY

Executive Summary

This submission reviews the Daphne Jackson Fellowship scheme, aimed at enabling highly qualified and trained women (or men) engineers and scientists to return to their careers after a career break because of family commitments.

It shows that investment in Daphne Jackson Fellowships brings with it a very high return to society at large, in both the long and short term.

It also sets out persuasive arguments for national investment in this scheme, and indicates a method by which this could be achieved.

1. *Daphne Jackson Fellowships*

1.1 An inspired Fellowship scheme (Appendix A) was launched in 1985 by Daphne Jackson, Britain's first woman Professor of Physics. The aim of the scheme is to enable high-level scientists and engineers to return to their professions after a career break. When the pilot scheme was launched in 1985, the response was high and nearly 30 Fellows were appointed from a flood of applicants. Most of these succeeded in rejoining their professions—a very encouraging rate of success.

1.2 Change is crucial in science and engineering. Constant attention is needed to keep up with the latest developments. A scientist or engineer who drops out, even briefly, can easily become a permanent loss to the nation's resources.

1.3 It is small wonder then that many people, usually women, vanish for ever from making a full contribution to industry or academia to raise children, care for the elderly or simply because of the relocation of a partner. It is commonly thought that this appalling waste of human potential, experience and training is unavoidable. The Daphne Jackson Fellowship Scheme has proved that this need not be the case and indeed has shown that such people can come back to full participation and productivity in their chosen professions.

1.4 Each Fellow retrains in the context of a guided research project. This is carried out on a flexible, part-time basis at a convenient university. The Fellow may, with the help of retraining, enter a new field and will certainly be making key contacts within the academic world as well as among potential employers in industry.

1.5 The Fellowship scheme could have ended with Professor Jackson's untimely death in 1991 but supporters such as British Gas and her own Physics Department at the University of Surrey made a new start possible. The Daphne Jackson Memorial Fellowships Trust (Appendix B) was founded in 1992 and has appointed a further eleven Fellows with key support from Leverhulme, Nuffield, the 1851 Commission, the Royal Society and the Royal Academy of Engineering. Each Fellowship costs about £25,000.

1.6 The Minister for Science and Technology has said:

> "Women have valuable skills which have to be better recognised and used to national advantage. One area which is important for the UK is science and technology. We must maximise the skills and expertise which women have in science and technology to ensure that women are able to realise their full potential. We have too few women considering science and technology careers, and those that we have in the science community are all too often lost or face slower career progress. This has got to change!"

1.7 Jackson Fellowships are an effective way of helping to change this situation. Indeed they are cited in *The Rising Tide*, the report to the OST, as "an excellent national scheme for women returners". *This report, by the Committee on Women in Science, Engineering and Technology, recommended national support and funding for successful returners' schemes.*

2. *Benefits of the Scheme*

2.1 Experience shows that Daphne Jackson Returners are highly able and highly motivated, as well as highly trained. It does not make academic or social sense for society to perpetuate a situation in which valuable resources are lost or under-used.

2.2 A Fellow who returns to a productive career in science or engineering has much to offer society as a result of her work. To this contribution is added the tax revenue gained by the country as a result of her earnings.

2.3 The rate of return to a productive career in science and engineering has been shown to be very high for Daphne Jackson Fellows: approximately 90 per cent of those completing Fellowships between 1985 and 1990 were found to be in appropriate employment in 1993 (see Appendix A). Common experience shows that this is a far more efficient input into the nation's science base than that achieved by initial PhD funding (valuable as its results are) in science and engineering subjects.

2.4 The host university of a Daphne Jackson Fellow benefits from up to 2,000 hours of input to a university research programme by a scientist or engineer who has been very carefully selected and who will be highly enthusiastic and motivated. A Daphne Jackson Fellowship is an excellent route for attracting good research resource at minimal cost to the department concerned.

3. *Operation of the Scheme*

3.1 The scheme is a national one, available to any woman or man of appropriate scientific or engineering background who is normally resident in the UK, who intends to enter appropriate employment in the UK on completion of a Fellowship, and who has had a substantial career break because of family commitments prior to application.

3.2 A typical Fellowship lasts two years and is carried out on a flexible part-time basis to enable the Fellow to meet ongoing family commitments. It is based at an accessible university and includes retraining and updating, plus a substantial guided research or development project. Retraining may include postgraduate lectures and seminars, with approximately 100 hours per year instruction in new technologies.

3.3 Fellows are encouraged to consider projects of practical importance. The Trust wishes to encourage collaborative projects between industry and centres of learning. A project must also demonstrate a relevance or application to present day needs in order to ensure the future employability of a Fellow.

3.4 With the help of the Trust Administration, a candidate contacts appropriate university science and engineering faculties to discuss possible areas for investigation—in her previous field of expertise, or in a related but different area.

3.5 The initial consideration of an application for a Fellowship is undertaken by the Trust administration who, if satisfied, follow up personal references and oversee the arrangement of an appropriate Fellowship programme with the potential university supervisor. Following confirmation by the Supervisor and the Head of Department of their willingness to accept the candidate, and the receipt of a satisfactory opinion from an independent technical referee, the matter is passed to a small but high level Awards Committee for final adjudication.

4. *Funding*

4.1 The Daphne Jackson Trust has received Fellowship support from charitable bodies, professional institutions, industries and individual universities (Appendix C). Approximately £525,000 has been given or pledged to the Trust since its establishment in 1992.

4.2 The total cost of a Fellowship is currently approximately £25,000. This covers the Fellow's salary, employers' National Insurance, superannuation, a contribution of £500 per year to consumables etc, and the Trust administration fee of £1,250 per year.

4.3 Without direct advertisement, the Trust receives a steady stream of applications from highly qualified, well-motivated would-be Fellows who have heard of the Trust from a wide variety of sources. The urgent need continues to find further funds to support able women (or men) as new Fellows.

5. *University Based Fellowships*

5.1 In mid-February a letter was sent to all UK Vice Chancellors and Principals from Trustees Professor Brian Fender and Professor Patrick Dowling urging consideration by the universities of the establishment of university-based Daphne Jackson Fellowships for the purpose of re-establishing high-level women scientists and engineers in their professions after a career break for family reasons. Appropriate men are also eligible. A copy of this letter is attached (Appendix D).

5.2 Imperial College, Loughborough University and the University of Surrey are already supporting the first such university-based Fellowships, and Lucy Cavendish College at Cambridge will follow suit very soon. Discussions are also underway with Keele, Bristol, Bath, Aberdeen and University College London.

5.3 Such a Fellowship is held at the university concerned, which provides some or all of the funding. The Fellowship is administered by the Trust. The presuppositions of such a Fellowship are that the Fellow should meet both the very high standards demanded by the Trust and stipulations of the university: and that the university, as well as the Fellow's proposed department and supervisor, should be fully consulted and committed prior to the award of any such Fellowship. University based Daphne Jackson Fellowships would ideally be awarded on a recurring basis, say every two years.

5.4 Several patterns of funding have been found viable. In some cases the university has matched internal funding by approaches to external sources such as local industry. Internal funding has been met from central and faculty funding as well as by contributions from the department concerned. Some universities have been able to provide the full funding package, others half or a quarter of the necessary sum.

6. *The Research Councils: An Opportunity for Action*

6.1 A window of opportunity is open at this time for the creative use of research funding in forming a link with university initiatives to establish university based Daphne Jackson Fellowships. Such a link might be made to great effect between universities and the Research Councils, with the creation of Research Council awards providing half funding for a certain number of Daphne Jackson Fellowships per annum, to be held at universities with a commitment to the scheme, the remaining half funding to be provided by the universities themselves.

6.2 The proposed link between the Research Councils and universities would maximise the effectiveness of Research Council funding for such purposes. For the relatively small cost of £6,250 per Fellowship per year, over two years, an award would succeed in bringing back to full productivity a highly qualified and dedicated scientist or engineer. Based on past performance (Appendix A), the percentage of such people likely to remain as contributors to the UK science and engineering base on completion of a Fellowship would be far higher than that to be found in a similar number of recent PhDs in science and engineering disciplines.

6.3 The proposed link between Research Councils and universities would make maximum use of the good will and participation of UK universities in this scheme, at a time when such participation is under active consideration.

APPENDIX A: PILOT PROJECT 1985–90

Number of Applicants (to 8/87):	140
Number of Fellows:	27
Background of Applicants:	Industrial Experience—41% MSc/MPhil—15% PhD—45%
Pilot Project Funding:	
Total Funds raised:	approx £600,000
Major Sponsors:	Leverhulme Trust, Nuffield Foundation, Laura Ashley Foundation, Electricity Council, British Telecom, GEC, Cable and Wireless, BP, ICL, BICC, British Gas, ICI, Shell, Fellowship of Engineering, Institute of Physics

Projects completed by Fellows:

High temperature superconductivity. Prolog profiler as an aid to optimisation of logic programmes. Instrumentation in power supply. Behaviour of new composite materials. Computer modelling in solid state physics. Biotechnology of degradation of wholemeal flours. Molecular dynamics in hydrogen-bonded complexes. Synthesis of natural products using organometallic reagents. Applications of computer science in biotechnology and molecular biology. Information technology in physics. Methods of management decision based on artificial intelligence. Applications of thermally stimulated currents. Pathophysiology in vertebrate hosts. Copolymers as an oral drug delivery systems. Design of microwave circuits. Information technology of man-machine interfaces for manufacturing systems. Muon spin resonance in physics and chemistry. Thermal and mechanical behaviour of high performance polymers. Biotechnology applied to food technology. Enzymology of oxidases present in mushroom wastes. Chemical and biochemical work based on NMR. Expert systems for computer aided teaching of formal computing languages (two Fellows). Structural studies of oligopeptides. Magnetic resonance studies of biological systems. Electrically enhanced gas filtration. Expert systems for computer systems development.

Participating Universities:

Birmingham, Bristol (3), Cavendish Laboratory Cambridge, University College Durham, East Anglia, Glasgow, Imperial College (3), Keele (2), Kent, Lancaster, Leicester, Loughborough, Reading (2), Stirling, Surrey (5), London School of Economics.

Subsequent employment of Fellows:

Chemist in process technology—ICI. Chemist joint Keele Univ/ICI project. Clinical Research Associate—Sterling-Winthrop. Systems Analyst—NHS. Primary School teacher aiming to supervise teacher training. Self-employed systems analyst and examiner for OU. Self-employed computing consultant. First Engineer—Nuclear Electric. Freelance computer consultant. Principle Lecturer, Electronic Systems, Bristol Poly. Lecturer, Adult and Continuing Education, Durham University. Associate Lecturer/Computing Officer, Surrey University. Lecturer, Biological Sciences, Keele University. Research Associate, Physics, Imperial College. Researcher, Oxford & Cambridge Exam Board. Research Fellow, Biochemistry, UWCC, Cardiff. Research Associate, Cognitive Science, Imperial College. Research Fellow, Computer Studies, University of Leeds. Lecturer, Computer Science, RHBNC. Research Assistant, Physics, Loughborough University. Lecturer, Coventry Polytechnic and OU tutor.

25 February 1995

Evidence from Mrs S Knudson

As a Petroleum Engineer, now working as a research associate at Imperial College, the points I make in my submission relate to questions 6 and 7 from the Call for Evidence. My comments and concerns arise from my experience through working in the petroleum industry for 12 years.

Question 6—(a) How do you expect the situation concerning women in science, engineering and technology to change in the next decade?

In the next decade I expect that the number of women entering the petroleum industry will increase. The number of women in middle/upper management should also increase as the number of women returners (those women who have had a career break for family reasons) increases reflecting the rise in the number of women entering the industry in the past decade.

I believe the rate of increase over the decade will be retarded unless industry as a whole addresses the problem of wastage. Where by, women leave the industry and do not return. The main reasons for this exodus being;

(a) Disenchantment with career progress and prospects. The growing perception that a woman must be better than her contemporaries to succeed.

(b) Limited opportunity to return to work following a career break for family.

Wastage has been a major problem in improving the situation for women in science, engineering and technology in the past decade.

In recent years some companies have started tackling the practical problems that women face by introducing childcare, jobshare, part time and teleworking schemes. In the next decade this should become more wide spread.

The need to address the problems of disenchantment with career progress etc. has not been widely recognised. Training of managers on how to supervise and develop women such that they achieve their full potential is not common. This must change over the next decade if it is to become the norm for women in science, engineering and technology to achieve their full potential rather than the exception.

Since becoming a research associate I have become aware of networks for women within academic establishments (AWISE,Daphnet). When I was working in the petroleum industry networks for women in science, engineering, and technology careers were not active. If companies were to encourage the setting an industry wide network in the next decade I believe it would provide a support, advice and information service that will help prevent women becoming isolated and disenchanted.

(b) *What should be done to make scientific careers more attractive to women and how?*

To make scientific careers more attractive to women government, industry, academia and professional bodies should;

(a) Make people aware that the common perception that scientific/engineering careers are not "socially" acceptable for women is not correct.

(b) Demonstrate that a woman achieving her full potential in a scientific career can be the norm rather than the exception.

(c) Show that a woman can combine a successful, fulfilling scientific career with family commitments.

(d) Commit themselves to policies aimed at retaining women in scientific careers.

This may be done by using the resources of government, industry, academia and professional bodies to produce an educational/information document which:

(i) Highlights that women have a role to play in science, engineering and technology and that a scientific career is rewarding both intellectually and financially;

(ii) Gives details of training options for School girls/School leavers;

(iii) Shows where to go to obtain expert advice for women seeking careers in Engineering and Science;

(iv) Gives Case Histories : Examples of successes in (b) and (c) above;

(v) Outlines tangible government, industry, academic and professional body policies aimed at improving the situation for women in science, engineering and technology. Such as:

- Setting up women in science, engineering and technology networks;
- Specific training for managers on how to supervise and develop women to their full potential;
- Introduction of optional mentoring schemes;
- Support for organisations whose aims are to improve the situation for women in science engineering and technology ie, WISE and Daphne Jackson Memorial Fellowships Trust.

This information document should then be used to "sell" the idea of women in scientific careers to the public by being made widely available in libraries, schools, higher education establishments, career advice offices etc.

Question 7—Master of Research (MRes) degree

I am not familiar with the guidelines for the MRes degree scheme. However, I believe it could be of considerable worth to women (and men?) returners. It would enable them to make use of their expertise through research, gain a qualification demonstrating their scientific/engineering capability and possibly regain contact with industry. As such a MRes degree may provide a stepping stone back into their industrial careers.

To maximise the benefits of the degree the scheme needs to be as flexible as possible. ie waive the requirement of a first degree from the host university and where practical and desirable allow teleworking.

Evidence from Dr Elizabeth McClelland, Palaeomagnetism Laboratory, University of Oxford

I understand from the Royal Society that the House of Lords Select Committee on Science and Technology is launching an inquiry into academic careers for research scientists. I am a Royal Society University Research Fellow, coming to the end of my 10 year contract. I run a very active research laboratory and have an excellent international scientific reputation. I am unable to move far from Oxford because we need to stay close to my five year old step-son, but am unable to get a job in my department, due to financial cuts, and am unable to find any suitable grant that I am eligible for to keep me in research. The issues of contract researchers are very real and problematic to me.

I have been discussing the issues of contract and research staff extensively with others in my department and other departments at Oxford and other Universities. I attach a document that I believe adequately crystallizes much that is of concern to many people in my position. I hope this will be of interest to the Select Committee.

RESEARCH TRACK CAREERS IN THE UK

It is clear that all soft-money research positions, be they PGRAs on research grants or Royal Society URFs, play a very important role in today's University system, especially for departments that are centres of excellence. The present system produces a large number of postdoctoral workers supported on research grants or personal fellowships who do a significant proportion of the research carried out in departments. Oxford University Earth Sciences department, for example, in September 1993 had 21 teaching staff, four University-funded research staff, one senior University-funded research staff member, 22 externally-funded research fellows, two externally-funded PGRAs and approximately 50 DPhil students.

The recent changes in University funding exacerbate already existing problems in career structure:

- The present system does not provide an adequate career structure for those who start on the postdoctoral research track after gaining a doctoral degree, hoping or even believing that they are preparing themselves for a life in an academic institution.
- Many more postdocs already enter the system each year than the number of academic jobs available.
- Many universities have ceased appointing to research positions as these are supported from the recurrent budget from which part has been transferred from the UFC to the Research Councils, yet Research Council regulations mean that established research workers' salaries cannot be met from grants except where a direct technical contribution that is specific to the project (as opposed to scientific) can be identified. This policy is applied even if the established researcher is essential to keep the facility running. This means that the Universities have lost significant support for established researchers in the funding transfer.
- A soft-money career to retirement is extremely difficult, as the number of personal fellowship schemes are limited, and almost all have an upper limit on age of 35 years.
- The Natural Environment Research Council no longer award salary to a Principal Investigator on a research grant. This means that Postdoctoral workers may continue for a considerable number of years on research grants on which they are officially research assistants, but are in fact principle investigators. A severe problem arises where a holder of a personal fellowship is the only specialist in a particular field in the department, becomes too old to apply for further personal funding, and there is no established academic available to act as PI on a Research Grant.
- Research council grants committees will insist on cheaper labour being employed when faced with a request for a Grade 2 research assistant for example, except under exceptional circumstances.
- If the present funding strategy continues, departments will need to win considerably more research grants than at present to survive. More people will be needed to do the hands-on research that teaching staff have little time to do. If a new approach is not made to the problem, then even more temporary research staff will be recruited by a system that has no need for them once they become too expensive. This is clearly a waste of trained manpower.
- If disposability has to become the norm, then perhaps it would be better to take on more Research Assistants, and encourage them to leave after a single contract, rather than encourage postdocs into long term postdoctoral funding, which will eventually die out when they are to old to retrain for anything else!
- The supposedly prestigious personal fellowships from the Royal Society and Research Councils are not supported by overheads, and may become financially disadvantageous for departments to accept.
- The Royal Society's 1993 review of the URF scheme shows that the early years of the scheme were very successful, with a high proportion gaining permanent university employment before the end of their fellowship. However, the scheme has recently expanded, with 141 URF's being appointed in the four years between 1988 and 1991, and considerable disquiet is felt by a number of present incumbents about their future in the academic world.

The scientific establishment should be encouraged to change their approach to this problem, and to considerably enlarge the number of senior research staff at Universities. Suggestions for action are as follows:

1. That Universities appreciate that permanent research staff may be more effective in bringing in grant money than teaching staff, and ensure that existing research positions are fully supported and not curtailed.
2. That the Royal Society and Research Councils should consider extending the age range of their personal fellowships to retirement age, to allow a career track to develop. These would have to be fixed term, but renewable. Numbers of fellows supported by the scheme would obviously have to be significantly reduced.
3. That the Royal Society and Research Councils should consider paying overheads for personal fellows in the light of the removal of dual funding, even though this would reduce the number of fellows supported by the schemes.

4. That all Research Councils allow PI's on research grants to be awarded their own salary. Where a named postdoctoral researcher will be making a considerable intellectual contribution to the research project, they should be a joint PI on the proposal.
5. That Research Councils re-consider their present policy of discouraging the use of postgraduate research assistants on research grants.

2 February 1995

Evidence from Pennie Ottley, Centre for Women in Technology, Design and Manufacture, University of Central Lancashire

EXECUTIVE SUMMARY

The issues surrounding women and technology are complex and there are no simple recipe solutions. Gender stereotyping and the dichotomy between the Arts and Sciences are deeply embedded in our culture. As neither is fixed or immutable there is hope for change.

There is a need for an overview of the situtation and a co-ordinated and strategic way forward; it is essential to bring together the plethera of literature and initiatives and develop a strategy based on well evaluated "good practice" and to ensure that such good practice is available in a variety of ways.

Recommendation 1: That a permanent national resource and information centre be set up to research and make available "good practice" to, especially, Schools, Further Education, Higher Education, Trades Unions, Professional Bodies, the Media and Industry.

Recommendation 2: A gender-inclusive curriculum network should be set up and co-ordinated by the national Centre and suitably funded. Information should be available and "good practice" initiatives should be co-ordinated, resourced, developed and pilotted and made available through a variety of methods.

Experience to date enables us to recommend the following initiatives in the form of recommendations.

Recommendation 3: That single sex provision in engineering and computing is resourced and supported at Higher Education level at least at Year 0.

Recommendation 4: Broaden the availability and resource professional updating schemes for women that recognise and provide for women's needs.

Recommendation 5: That funding is provided for the development of an elective at Higher Education level to facilitate women's experience with physical (both mechanical and electrical) devices and that this is made generally available.

Recommendation 6: That a core "Equity in Education" staff development workshop be resourced, developed and pilotted and all information be made generally available.

Recommendation 7: That positive action campaigns for posts at Higher Education level should be encouraged and resourced and clear guidelines made available.

BACKGROUND TO RESPONDENTS

At the Unversity of Central Lancashire, the Faculty of Design and Technology in general and the Centre for Women in Technology, Design and Manufacture in particular have been active in encouraging girls and women to positively consider a career in technology; to enable them to gain access to technical courses at higher education level and to ensure that the learning environment is appropriate for their needs. The University as a whole has a deserved reputation of being in the forefront of its peers in developing, implementing and embedding equal opportunities.

The UK Partnership Award, the 1991 GEC MARCONI prize "Women into Engineering" was awarded to the Centre for the holistic approach adopted in encouraging women into engineering. The University, through the Faculty of Design and Technology jointly organised and chaired an International Conference with the Beijing Institute of Technology entitled The Development and Role of Women in Technology. This was held in Beijing in September 1994. The recommendations from that Conference are being fed into the 4th International Women's Conference to be held in Beijing in 1995.

We are members of the following networks and associations: Women in Computing; Women in Technolgy in Further Education; Women in Higher Education Network; Women's Engineering Society; Gender and Science and Technology Association; Gender and Mathematics Association; Women in Construction Alliance; IRIS, the European women's vocational training network; Women in Technology in the European Community.

Our evidence stems from a perspective situated in Higher Education: a teaching, learning and research establishment and an employer of women scientists and engineering and computer scientists. We concentrate primarily on the latter two categories, women engineers and women computer scientists.

Issue (6) What should be done to make scientific careers more attractive to women, and how?

It must be stressed at the outset that there are no easy solutions to these questions. Gender stereotyping is deeply embedded in our culture as is the dichotomy between Arts and Sciences. The process of change must be viewed over the long-term and the short-term actions must be carefully monitored and evaluated and the experiences and results shared in appropriate ways. A particular problem at present is the lack of a national information and resources "centre" which would enable easier access to the plethora of research and activities that are ongoing in this country, in Europe and internationally. Many people are continually re-inventing the wheel. Others are initiating successful activities without this information being available to others. It is to be hoped that the Development Unit set up as one response of the Government to "The Rising Tide" will at the very least begin to address this.

> *Recommendation 1:* That a permanent national resource and information centre be set up to research and make available "good practice" to, especially, Schools, Further Education, Higher Education, Trades Unions, Professional Bodies, the Media and Industry.

Demographic changes into the next century mean that women will be encouraged to enter and re-enter the workforce. Foundations and Companies in the United States of America are recognising the impact that the predicted demographic trends and changes in working practices (including temprisation, Greenbaum, 1994) will bring and are targeting resources into Women into Engineering Programmes (personal communication, University of California at Davies).

Metaphors for women's careers in general may be that of a "spiral" or a "web" rather than a "ladder". The "normal" career metaphor is a "ladder" and this is the route that males tend to take. This is also the route that employers and Professional Bodies tend to favour. Implementing career-break professional update schemes enable women to return to professional engineering work as do child and elderly relative care provision, but neither address the reasons as to why is is primarily only women who need these updates and are assumed to shoulder all responsibility for care, and men do not. It is the organisation of work itself that is problematic, the expectation that men will dedicate themselves to the public sphere of work whereas women, whilst allowed to practice in the public sphere must balance this with their private (domestic) activities. Positive change for women cannot occur until men recognise and take on domestic activities and therefore require the same types of schemes. This is a general problem for professional women (see, for example, PSI Distributors, Doctors & their Careers: A New Generation, 1994, where it is reported that women are disadvantaged by a "straight" career path, higher status of full-time working, patronage and geographical mobility).

This does not mean that nothing can be done. One approach is the integration of equal opportunities with total quality management; a recent paper by Shapiro (1994) attests to interest shown by certain companies with this notion. Such initiatives need careful monitoring and evaluation and information on their success or otherwise made generally available.

One long term aim should be the full integration of continuing professional update programmes (WIT Returners Scheme, Open University, Swarbrick, 1994) for both men and women. The short-term aim should be to ensure, that women who wish to return to an engineering or computing career have well-supported access to schemes. That recognise and meet women's needs. Child and elderly relative-care provision must also be made available both during the updating process and beyond.

> *Recommendation 4:* Broaden the availability and resource professional updating schemes for women that recognise and provide for women's needs.

There is some evidence that some women engineers do not wish to be the target of positive discrimination (Sharpe, 1994) in recruitment. There is still a misunderstanding of the significant difference between positive discrimination and positive action. The latter recognises that women have suffered discrimination in the past and that methods of recruitment that take this discrimination into account are necessary, but that only candidates possessing the desired qualifications and qualities should be appointed. The Faculty of Design and Technology has been successful in attracting women engineers and computer scientists by carrying out a positive action recruitment advertising campaign (personal communication, Margaret MacKeith).

> *Recommendation 7:* That positive action campaigns for posts at Higher Education level should be encouraged and resourced and clear guidelines made available.

The issue of harassment both in education and the workplace is a difficult but very necessary issue to address. Developing, implementing and monitoring a policy of Harassment facilitates reflection which enables identification of boundaries and sources of power within relationships and facilitates understanding of difference, not only between men and women but also minority and majority ethnic groups, classes, disabled and more abled people and those with different sexual orientations. Handled appropriately this can have a positive effect for women (and all disadvantaged groups). It is vital that adequate resources are provided for the requisite support systems.

Moving on to the more specific area of women's engineering and computing careers, this is a substantial body of information and description of iniatives relating to parents and schools (including WISE, 1994; WiC, 1992: GASAT conference proceedings). Access to this information is not particularly easy and the development and implementation of initiatives appears to have been carried out in an ad hoc and uncoordinated fashion. There is some suggestion that the equal opportunities-based approaches have not been shown to work effectively (Henwood, 1993, Fitzsimmons, 1994). We would argue that it is the ad hoc equal opportunities-based approaches that are not embedded within the fabric of the organisation and the discipline that do not work. Nor do those that rely on a "critical mass" hypothesis. There has been an emphasis on image and presentation, a tinkering with the system, and not enough, we believe, on the nature and content of the disciplines, the teaching and learning process or the culture of the places where engineering and computing are practiced. These notions are deeply embedded but, as social processes, are not fixed and immutable and are thus open to change (Wajcman, 1994).

The Swedish Council for the Renewal of Undergraduate Education has been given the responsibility of tackling the three issues noted above—the content, the teaching process and the culture of engineering education (Ullenius, 1994). The Open University in the Netherlands is also working in this area (Crutzen, 1994). The International Conference held in Leeds 1994, Engineering Education and Professional Practice: Developing Gender-Inclusive Models (Carter, 1994) identified curriculum change and staff development as the two areas in greatest need for action. Concern was also expressed in this area at the 1994 Beijing Conference (Bennett, 1994).

How this should be done is, again, not open to a simple recipe approach. Curriculum development cannot take place in a vacuum, there needs to be close co-operation between industry, education and professional bodies. Staff must be given adequate resources, including time, to work towards an inclusive curriculum. Information must be exchanged on a regular basis. Technology-mediated communications facilitates such exchange but is not sufficient. A network (National, European and International) should be set up as part of the co-ordinating centre recommended above (Recommendation 1). Resources must be made available for workshops (for example, where a small number of participants share detailed information on particular processes), seminars (for example, for "brainstorming" particular areas) and conferences (where many delegates meet each other and present a variety of related information in a variety of formats).

> *Recommendation 2:* A gender-inclusive curriculum network should be set up and co-ordinated by the national Centre and suitably funded. Information should be available and "good practice" initiatives should be co-ordinated, resourced, developed and piloted and made available through a variety of methods.

It is recognised that mature women and young women entering engineering and computing have not had equal experience with physical devices as their male peers. One successful method to overcome this in the short term has been the operation of an elective in Higher Education that facilitates women's access to this practical "hands on" experience (Henderson et al, 1994). This elective was developed in the USA with the support of the National Science Foundation. Such an elective should be developed to meet the needs of women in the UK and piloted and evaluated appropriately.

> *Recommendation 5:* That funding is provided for the development of an elective at Higher Education level to facilitate women's experience with physical (both mechanical and electrical) devices and that this is made generally available.

There is evidence that Women Returners do seek to start careers in engineering and computing. There is also evidence that single sex provision is necessary at least in the short term. Examples of successful women-only courses are at the University of Huddersfield, an Access course and the Foundation year for the BEng at the University of Central Lancashire. The European Community recognises that such single-sex provision is necessary and funds certain aspects of the course. However, there is no continuing certainty that funding will be continuous and applications have to be made each year.

> *Recommendation 3:* That single sex provision in engineering and computing is resourced and supported at Higher Education level at least at Year 0.

Widening access generally to higher education has led to an examination of the processes of teaching and learning. As part of our policy of equal opportunities the University of Central Lancashire has developed a policy of equal opportunities in academic affairs. These relate to a wide spectrum of activities—including recruitment, language, teaching and learning and assessment. We are attempting to implement this policy through staff development workshops that enable participants to reflect upon their work and how they may be (inadvertently) discriminating against groups of people in subtle ways. However, there are no definitive answers, no simple recipe and we recognise that we are all in need of these reflections and discussions. Gender Equity workshops have operated successfully in the USA (Ghaussi & McGuinness, 1994; Personal communications, Wini Anderson University of California at Davies). This type of staff development requires resources both to develop suitable workshops and to run them successfully. A central core should be generally available which can subsequently be tailored to meet needs at individual establishments.

> *Recommendation 6:* That a core "Equity in Education" staff development workshop be resourced, developed and piloted and all information be made generally available.

Other initiatives that are usefully embedded are mentoring schemes for both staff and students. These encourage career development for staff and provide good peer support for students.

Considerable effort has gone into ad hoc developments in attempting to attract women into engineering and computing. Considerable experience has been developed and the time is right for a strategic appraisal and a co-ordinated way forward. Recommendations 1 and 2 suggest the focus for such a co-ordinated approach and Recommendations 3–7 are initiative oriented.

January 1995

Evidence from Mrs K M de Reuck

Executive Summary

This is a personal view after 30 years on short-term research contracts in a university environment. My concern is with the waste of talent resulting from low morale, high levels of anxiety and social isolation of many contract researchers. My personal recommendations are:

- Appropriate titles to be used nationally for all contract research staff to reflect their levels of responsibility.
- Appraisal, career advice and development opportunities to be the same for contract research staff as for tenured staff.
- All contract research staff to be given opportunities for decision-making roles in the university community.
- Bridging funds for the gaps between contracts to be set up by adding redundancy payments to all contracts.

Introduction

My contribution is a personal viewpoint from one who has recently retired as a professorial research fellow after 30 years as a contract researcher in London University. My experience, I suspect, is not typical in that I worked for the same international centre throughout that time—the International Union of Pure and Applied Chemistry (IUPAC) Thermodynamic Tables Project Centre—and was its Deputy Director for the last ten years, during which I had full responsibility for all its scientific work. Nevertheless, I have been subjected to most of the stresses and problems which currently face contract staff.

In response to the Royal Society's 1991 "Science Enquiry", which was published in 1992 as "The future of the Science Base" [1], I contributed some comments on the position, at that time, of fixed-term researchers and am discouraged by the slow rate of change.

My main concern in presenting these comments is to encourage the more efficient use of our national resource of qualified and experienced scientists and engineers.

Whilst I appreciate that tenure is no longer the norm for academic teaching staff I will use it to distinguish between the academic teaching staff with secure job prospects in contrast to the uncertain prospects of the contract researcher.

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

There are no career structures for the majority of post-doctoral fixed-term researchers, only a salary scale.

The main benefit of the short-term contract is to enable immediate post-doctoral researchers to widen their experience before selecting their future field of work. However, whilst tenured academic researchers can choose the fields in which they wish to work, fixed-term researchers are limited to the contract work available at any one time and at the end of each contract they may have to change to a new field or perhaps to a new career, possibly with corresponding waste of experience. So not only are contract researchers generally without autonomy but also they are not given the kind of managerial support and career structure which is provided for those in industrial R&D laboratories and in Government research.

Status is at least as important for morale as salary level and at many institutions all fixed-term researchers are still known as "Research Assistants" for all grades from IB—postgraduate student level—to grade IV at professorial level. The term "assistant", originally also used for lecturers and professors, was deleted from academic titles many years ago. I think its use should now be abolished for all research grades except perhaps for IB level when that is used to fund postgraduate students. The choice of titles for all other grades should apply uniformly throughout the university system, and should reflect the levels of responsibility which are held. For example, at Imperial College, a few years ago new titles were agreed for all grades above IB: Research Associate, Research Fellow, Principal Research Fellow and Professorial Research Fellow. My own morale was considerably enhanced when over-night my title was changed from Research Assistant to Principle Research Fellow. The implications of the title of Assistant is both demoralising and counter-productive for those who are carrying considerable responsibilities.

So uncertain is the status of research staff within institutions that they are often unclear even as to the category to which they belong; sometimes they will be classified as "academic", at others as "academic related" and on still other occasions as "research and analagous". So research staff are unsure as to whether they should respond to general invitations or instructions for say, "academic" staff.

The national academic community is a professional body where the titles of the tenured academic teaching staff are shared and their status understood by all. In order to assist in building a career structure for the contract researcher within the national professional community, a set of titles should be developed which would be used nation-wide and would represent their true status within the university system.

In the days of continuous expansion within the university sector the post of research assistant was mainly used as a temporary appointment for those who would eventually join the tenured academic staff. Since the arrival of "steady state" funding the number of research staff has grown and the number of academic posts has diminished, so that transfer to tenured status is now no longer common. The result of this is that there is no provision at most institutions for the participation of the fixed-term researchers within the management structures. It is frequently said that fixed-term researchers are temporary staff employed for only two to three years, and so have no rights or responsibilities for the future of their institutions. This is not an argument which is used about student participation.

The feeling, which is prevalent among research staff, of not being a full member of the community is severely counter-productive to the current aim for improving the research base, which requires research staff with high morale.

During my 30 years on short-term contracts from various government departments, the old contract almost always ended before a renewal had been confirmed and signed. As a result the research workers at my Centre have been left without any contract for periods from 3 months to a year. Salaries were sometimes temporarily covered, or were paid retrospectively, but no other expenditure, such as for equipment, was allowed before the contract had been signed. This pattern has not changed with the years—if anything the situation is worse now than in earlier years. Applications for renewal were always made at the time requested by the grant-giving body—usually at least 6 to 9 months before the end of the current contract. Verbal assurances of eventual renewal were generally given, but this is no substitute for a formal contract for those who have mortgages to pay or families to support. Some form of bridging funding would greatly reduce some of these anxieties and hence permit researchers to greatly enhance their contributions.

At present many institutions require contract staff to sign away their right to redundancy payments when they accept their contract. This is to put all the burden onto those least able to carry it.

Appraisal and career development are possibly even more important for the fixed-term researcher than they are for the tenured teaching staff, whose job security is far greater. I shall not refer to the case of those studying for a PhD, since they are in the same category as research students funded by other means, and require the same training and development opportunities. For post-doctoral contract research workers career guidance and opportunities for learning new skills or re-training are essential if the best use is to be made of their knowledge and experience already gained, not only for the individual but also for research in general and ultimately for the national well-being.

2. *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

For several years now, at my own institution, the largest category of workers is that of the fixed-term researcher. According to the recent AUT survey [2] contract research staff employed in the "old" UK universities now account for 34 per cent of academic staff. So already this sector is probably too large, especially in those institutions which have not fully incorporated these workers into their management structures. Not only is this damaging to the morale of the research staff but it also deprives the university of the advice and fruits of experience of those most closely involved in the research programmes. Clearly any increase in numbers would only exacerbate the existing problems and disadvantages.

3. *How do you expect the situation to change in the next decade?*

The change in science funding from that of continuous expansion to the present "steady state", is the cause of many of today's problems, the major consequences of which are fully explored in Ziman's [3] recent book. One of these consequences is that a growing proportion of university income is now derived from the overheads for contract research and there is at present no sign that this is likely to slow down in the near future. Since it is of increasing economic importance that the contract research is carried out to the greatest effect, it requires not only that the staff are of the highest calibre but also that their morale is high so that they can make maximum contributions.

At present fixed-term researchers are generally treated as peripheral to the main functions of a university, but they are now an essential part of the development of a strong research base, and some re-structuring of the system is required in order to incorporate them fully within it. There is an untapped source of talents and skills which could contribute to the general well-being of the universities.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

Since more women attain posts in the contract research sector of universities than as tenured academic teaching staff, any of the suggestions for improving the conditions for contract researchers in general will help to improve the position for women.

The Royal Society recently announced [4] a number of new measures which have been introduced to give greater support to the young women scientists holding the Society's fellowships. These include enabling the fellows "to claim back maternity leave, convert fellowships between full-time and part-time to fit in with family commitments and claim some extra funds for items such as the cost of taking a child to a conference, or the cost of employing a research assistant to undertake field work during pregnancy or while children are young". Clearly, such measures as these, if applied to all contract research staff would make research careers more attractive to women. The ability to choose full-time or part-time work might well be attractive to both men and women young researchers.

There will always be a number of women scientists, technologists and engineers who will choose to take a career break in order to care for their children themselves. The experience and talents of these qualified women need not be lost if suitable retraining is available together with appropriate returners fellowships such as those at present provided by the Daphne Jackson Memorial Fellowships Trust.

Recommendations

1. In order to raise the morale of contract staff and thereby increase the efficiency of their contribution, at almost no cost, a consistent set of appropriate titles should be agreed and used nationally throughout the university sector.

2. Contract research staff should be appraised in the same manner as the tenured academic teaching staff and should receive the same career and development opportunities.

3. All research staff on contracts should be incorporated into the university structures so that they can participate in and contribute to the decision making.

4. Redundancy payments should be built into all contracts, and when these are not needed, either because the contract has been renewed or a new one obtained, they should be paid into a bridging fund.

References

[1] "The Future of the Science Base", Royal Society, London, September 1992.

[2] Bryson, C. and Tulle-Winton, E. "A survey of contract research staff in UK universities", on behalf of the Association of University Teachers, Autumn 1994.

[3] Ziman, J. "Prometheus Bound: Science in a dynamic steady state", Cambridge University Press 1994.

[4] Royal Society News, vol. 7, Number 10, July 1994.

January 1995

Evidence from Rolls Royce

1. *What are the problems and advantages of the current career structures for academic scientists in the UK?*

1.1 The problems are those associated with a disproportionate growth in the number of short-term (usually 3-year) research staff positions compared with the number of established posts for academic staff. The danger is that a post-doctoral research assistant (RA1A) may stay for too long in a particular department by moving from one 3-year contract to the next, whilst waiting for an academic post to appear. It is quite easy for such a person to have difficulty in remaining a truly innovative researcher, at the same time becoming a less attractive candidate for either an academic staff post or an industrial position.

1.2 In some university departments it is, however, possible to stay on the "research ladder" and graduate to prestigious levels, as exemplified by the positions of Assistant Director of Research or Senior Research Associate at Cambridge University.

2. *What are the advantages and disadvantages of the growth in short term research contracts in academic science?*

2.1 The advantage to industry is that there is a ready source of highly-qualified but relatively low-cost candidates for work in the universities. There is a 1:2 ratio between the costs of an RA1A and an internal employee, a factor that, together with the lack of any long term commitment to the RA1A's career, pension, etc now makes it increasingly financially attractive to industry to outsource work to the universities.

2.2 The disadvantage is the corollary 2.1, ie industry may find that it is effectively growing an "under-class" of short-term contract labour that could become disaffected if it felt that it was being exploited by companies that had no interest in its long term future.

2.4 The Teaching Company Scheme remains the exception to this, where the principles of the scheme state that it is *expected* that the Teaching Company Associate (TCA) will be offered an industrial position after his/her 2 years in the scheme. (Although the TCA is not strictly a research appointment, in practice the work undertaken can be quite close to that of an industrially-oriented Research Assistant.)

3. *How do you expect the situation to change in the next decade? (Please bear in mind, among other factors, the current age structure in full-time academic posts and expected changes in university income levels and sources.)*

3.1 No comment.

4. *What information do you have concerning the destinations of those scientists who have left the contract research sector of an academic science?*

4.1 No comment.

5. *What should be done to improve the mobility of scientists between academia and industry?*

5.1 It is already quite easy to arrange for extended secondments (say, between 3 months and 3 years) of academics to industry and vice versa. A number of financial mechanisms exist to aid movements in either direction. The academic staff member necessarily has to plan for such a secondment to take place during a sabbatical, whilst it is usually the younger company engineer who is seconded for one or more years to undertake research coupled with registration for a higher degree.

5.2 In the particular case of the Rolls-Royce University Technology Centre (UTCs), a much more intensive day-by-day mobility in both directions is also actively encouraged. This works very well to promote a more creative and productive working relationship between the UTC and its sponsoring departments inside the company.

5.3 However, it is probably true to say that such schemes have not produced many examples of either temporary or permanent movements from academia to industry at the RA1A level. Drawing a parallel with the CASE studentship scheme, it should be possible for EPSRC to insist that RAs recruited to work on research grants co-funded by EPSRC and industry should be given the opportunity of spending, say, three months on-site at the co-funding company during a three year contract, with pro-rata periods for shorter contracts.

6. *How do you expect the situation concerning women in science, engineering and technology to change in the next decade? What should be done to make scientific careers more attractive to women, and how?*

6.1 The continuing movement in the UK towards more flexible patterns of employment (flexitime, more part-time working, teleworking, extended career breaks, on-site nursery schemes) is, in practical terms, the most powerful encouragement for women to move towards scientific careers in both academia and industry.

7. *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the worth of this scheme.*

7.1 The indications are that the MRes initiative will serve two distinct and very useful purposes. Firstly, it will influence and enhance the training giving to the *majority* of research students (ie not just those on the MRes pilots) in both research and transferable skills.

7.2 Secondly, it will provide industry with a new opportunity to sponsor post-graduate students for one year during which they will be trained in skills of direct interest to industry and also (if well co-ordinated within say, an overall UTC programme) will be able to under-take a useful piece of research work.

8. *Summary*

8.1 Industry needs to be aware of the dangers of over-exploitation of post-doctoral research assistants in the climate of the present supply and demand imbalance with respect to academic posts. Mechanisms should be developed by EPSRC to enable RA1As who are working under collaboratively-funded research grants and are interested in the prospect of an industrial career to move towards the more favoured status of the Teaching Company Associate (see 2.4) or the CASE student (see 5.3)

Evidence from the Royal Astronomical Society

The following responses to the questions raised by the House of Lords Select Committee are the result of consultation within the Royal Astronomical Society. They therefore represent the views of professional astronomers and geophysicists who are active in areas of physical science to do with the Earth, the solar system, stars, galaxies and cosmology as a whole. The sophistication of the astronomical and geophysical problems being studied demands a very high level of technical competence in both the design and use of complex instruments, in the manipulation of data with computers and in interpretation and theory. The members of the RAS Council therefore include theoretical physicists, instrument scientists, observational scientists and applied scientists. The responses are numbered to correspond to the questions raised in the request for information.

1. CAREER STRUCTURES FOR GRADUATE SCIENTISTS

The chances of a planned career in academic life for any but the most brilliant postgraduate scientists are very small. Even in a steady state the replacement of academic staff in a university department probably requires less than two per cent of the graduate output of the teaching process. It can be claimed that up to 10 per cent of the current graduates from British Universities in physical sciences are of a calibre that would be appropriate for a research and teaching career at universities. The chances of a graduate achieving a permanent academic post will therefore always be small. The first decision that a graduate must make is whether or not to proceed to post graduate training or to enter employment. Although the opportunities to obtain postgraduate grants are reasonably well matched to the numbers seeking them, many able graduates are dissuaded from further training by the lack of academic positions at a later stage. However, these graduates may not have reached the point of their development where a move to industry would be optimum and as a result the university system is not playing as great a part in training scientists for industrial posts as it might do. It must be remembered that the brightest 10 per cent of graduates are the future leaders of research, the inspirers of new generations of students, and the teachers and academic leaders of the future. For only a small fraction of these to experience the benefits of a fertile academic environment means that industry is receiving staff at the graduate stage whose careers would have developed further if they had been allowed more time in the university environment. A similar loss to the academic world occurs when good post-graduate students do not progress to become research assistants, again because of the lack of career structure. The above are the disadvantages of the present system. The main advantage of the present system is that only the most dedicated and highly motivated proceed to postgraduate and post-doctoral work.

2. SHORT TERM RESEARCH CONTRACTS

Contract researchers are a great benefit to physics departments under conditions such as those presently experienced where basic research is under very great financial pressure. Post-doctoral scientists have reached the point of maturity at which they contribute significantly to research programmes, by carrying out research full time, which academic staff are unable to do because of teaching and administrative duties, and often by contributing to the encouragement of postgraduate students. In a climate where further staff positions are unlikely most academic staff would welcome more post-doctoral research assistants. However, there are disadvantages of contract research compared to a staff position. The situation is highly unstable in the long term and a large fraction of a three year fellowship may be devoted to finishing work on the previous project and searching for the next one. Scientists can hardly be expected to produce their best work if much of their time is spent worrying about where their next job will come from. Morever, the loss of a person with key expertise after three years may cause serious disruption to a research programme. Careful planning is needed to ensure continuity and when (as now) money for research grants is very tight a gap in contract support is very damaging. The contract researchers make considerable sacrifices in their personal lives to stay in the research field that interests them. The SERC did introduce changes to allow a three year position to be extended for a further three years, in exceptional cases, and this was welcomed. In our areas the general conditions of the contracts (the relevant Research Councils have an age related salary scale) are not a major source of discontent.

3. THE NEXT DECADE

The increase in the number of academic staff retiring from academic posts over the next 10 years will be of assistance in absorbing more young, academically minded graduates but only in the short term. As proposed in the introduction, the steady state replacement rate of academic staff does not demand a large fraction of the brightest graduates. The existing five year Fellowships for outstanding researchers in their thirties should be continued to maintain a pool of candidates for future positions. Although Universities plan their own staff replacements, they should be encouraged to ensure that physics positions are at least maintained. The presence of the "new" universities may briefly aid the situation in astronomy. There is demand from undergraduates for courses in this area and in environmental aspects of earth sciences, as part of overall physics degrees. But the steady state problem remains.

4. Destinations of Contract Researchers

The major employer of physical sciences graduates is industry, especially the electronics industry, work involving computing, government departments, but also non-scientific employers. The physical sciences, and in particular astronomy and geophysics, are especially effective in training students to a high standard in a wide range of transferable skills. These include experience in instrumentation, optics, electronics, computing, data analysis and statistics as well as the main scientific disciplines studied by the students. The frequent requirement to work in teams and write proposals to meet national and international deadlines gives valuable training. There is generally little difficulty in finding employment for these talented and motivated individuals. However, in the absence of academic careers in the UK many researchers move abroad, particularly to the USA, where contract support can be more extended. Although this is matched to some extent by the numbers of researchers coming to the UK, the latter usually return to their country of origin so that the experience does not remain in the UK. Some of the UK researchers are tempted back to hold prestigious five year Fellowships offered by PPARC and the Royal Society.

5. Mobility between academia and industry

If tax incentives were available to UK industry to support extra research posts at academic institutions this would indeed be beneficial to the career structure for scientific graduates. It would be most beneficial if industry used the tax incentives to set up permanent relations with an academic department so that graduate scientists might have a long term career working in an academic environment but with a defined relationship to an industrial user of the research carried out. Such posts which might be classed as "industrial implants" and would be an enormously fruitful way of encouraging and cementing links between industry and academia. While they do not in principle require tax incentives to make such a scheme work nonetheless an added inducement to industry to consider such novel arrangements would be very welcome. There are a few Fellowships available through the research councils for academics to spend a year in industry, and vica-versa. With a relatively small amount of additional funding this scheme could be expanded. While academics can move to research in industry, taking leave from their University duties, it is harder for those from industry to participate in all the activities required of a University employee. Although someone from industry could similarly collaborate in research, an exchange would usually leave a Department short of teaching staff. If exchanges of staff are to be encouraged University Departments may require additional funds to support replacement teaching; this would also offer some opportunities to younger people. The ROPA scheme for funding joint research between industry and the Universities can in our areas be used to exploit research which is aimed at understanding fundamental science.

6. Career Structures for Women

Women experience special difficulties in seeking a long term career in academic life because of the demands of child bearing and rearing. It is unfortunate that the increase in the numbers of women entering university and post graduate work has come at a time when the number of academic positions has not increased. It will be difficult to encourage more women into the physical sciences until they see more women in academic positions. If a career break has been taken, the additional expense of employing an older person, if only by a few years, mitigates against women. There are steps which may be taken to improve this situation such as better maternity leave allowances and child care facilities on-site at universities which are better matched to the lifestyle of academics than administrative staff. Tax relief for the cost of child care needs to be more widely available; the present conditions are too restrictive. Since young women no longer expect to sacrifice their careers on marriage, any more than does a young man, there will be increasing problems for young couples seeking employment in academic posts. The mobility required for taking a number of short term positions causes additional difficulties for young couples. The particular problems of academic careers for women have been addressed in the report entitled "the Rising Tide" commissioned by the Office of Science and Technology.

7. The MRes Scheme

There is very little support for the MRes degree in the fields of astronomy and geophysics since most academic departments are moving very rapidly to a 4 year degree in these subjects, which will incorporate training in transferable skills such as were required in the proposals for the MRes scheme. The disadvantage of single year course being required before entrance to higher degrees may well dissuade some students from staying on at university to gain the benefit of the research environment.

General Comments

From the responses listed above it is clear that graduate scientists wishing to take up an academic career have to face a long period of career uncertainty before they will find a suitable academic post. Prior knowledge that this is a very difficult and uncertain process certainly changes the minds of many who are bright enough to expect distinguished careers in academia. If they concluded that such a career path was too difficult and therefore decided to move directly to industry where their contribution might be considered of equal value then the UK funding for the science base would be resulting in a flow of well trained and younger graduates into appropriate industrial positions. The fact that this is not efficient arises from the need of young graduates to obtain experience in a research environment which industry cannot always provide. If a scheme such as the "industrial implant" scheme were set up with a sufficient level of stability to attract young researchers for the early part of their career then they would be encouraged to spend longer in an academic environment and when their final decision to move towards an industrial career came, they would be better trained and more effective in support of the UK's industrial competitiveness.

The main problem in the current situation is that all the brightest graduates face a long period of career uncertainty and this turns away many of the research leaders of the future to less appropriate careers. This cannot be in the interest of the UK.

31 January 1995

Evidence from the Royal College of General Practitioners

The Royal College of General Practitioners thanks the House of Lords Select Committee on Science and Technology for its invitation to give evidence to the Sub Committee under the Chairmanship of Lord Dainton to enquire into academic careers for graduate scientists.

The Royal College gives evidence only in relation to those graduate scientists who are both medically qualified and are working in or are researching on general practice.

1. CAREER STRUCTURE

The College is extremely concerned about the career structures for scientists who wish to work in general practice/primary care. An appendix is enclosed of a paper by the current Chairman of Research of the Royal College of General Practitioners which outlines many of the obstacles published in the *British Medical Journal* faced by research workers in general medical practice. The College does not believe there are any substantial advantages to the currrent system and is looking for a radical reform of current arrangements.

2. SHORT-TERM RESEARCH CONTRACTS

The advantages of short-term research contracts are the substantial flexibility they give to university departments who are becoming much more entrepreneurial and a major advantage is that a research worker who goes off the boil or loses enthusiasm or skill can be easily removed without any contractual or redundancy problems.

The disadvantages are paid first by the research workers themselves who have no security of contract, no security of income and no certainty of any further work. This must therefore represent a major disincentive to pursuing a career as a graduate scientist. The disadvantage for the university department corresponds and consists of a substantial difficulty in maintaining even successful research teams. It is extraordinarily difficult to secure grants in the modern competitive atmosphere and assure them they are consecutive so that key members of staff are not left without funding.

3. CHANGES IN THE NEXT DECADE

We have no doubt that the major changes in the next decade can already be foreseen. Universities are becoming much more competitive and university departments are becoming more competitive within them. There is ever increasing evidence on output and often short-term output, with consequential problems for pre-protocol curiosity-driven research and threats to reflective, contemplative work which may enhance the development of the discipline. On the other hand the rigorous competitive atmosphere is stripping out some less able colleagues and is likely to lead to a sharpening of the competitive edge of university departments and British universities as a whole.

CHANGES

The Royal College of General Practitioners has a small majority of all its new members who are women; it is therefore particularly concerned to ensure that flexible systems emerge which make it possible for those graduate scientists who are women to be able to complete their training and undertake research whilst at the same time fulfilling their personal and family roles. Part-time work and training and flexibility and particular modular training in research becomes of increasing importance.

In relation to question 6, the main requirement is flexibility in training arrangements and in particular modular training and part-time training arrangements, and also of course part-time work.

4. GOVERNMENT'S MASTER OF RESEARCH (MRES)

The Royal College of General Practitioners welcomes this and believes it is the logical development which it supports. It does, however, think it is important that there should be opportunities for graduate scientists to concentrate on behavioural science research and qualitative research methods rather than exclusively concentrating on the natural sciences. The College believes that about half the problems faced by patients coming to the British National Health Service have their roots in the environment and that behavioural environmental sciences are likely to be the keys to elucidating them.

Professor Denis Pereira Gray
Chairman, Research Network

January 1995

Evidence from Professor J R Sambles, Department of Physics, University of Exeter

EXECUTIVE SUMMARY

There is an urgent need for a cultural change in the UK towards an awareness and appreciation of the significance of science and engineering.

All infant and junior school teachers should have a working knowledge of mathematics and science.

The route to academic positions through research fellowship is now largely established in science yet unlike in many other careers the junior post is not long term with progression to senior posts being rewarded for ability and/or effort. For many the junior post is simply a dead-end.

Encouraging more students at a lower level to read hard sciences would allow expansion of academic posts in higher education providing the potential for longer term stability. This is currently unlikely.

The MRes scheme nees to be abandoned—it only adds another year of uncertainty. If it is required then it should be through secondment out of those industries that maintain it is needed.

Dear Sub-Committee II.

Before addressing your specific questions there are three contextual matters which need consideration:

- Firstly, on the world scene—we are living in a progessively more technologically dominated era—if in Britain we do not soon address the lack of reward for and encouragement of technological excellence we shall inevitably become a purchaser rather than a supplier at dire costs to our national ecomomy.
- Secondly, the national awareness of Science and Technology is appalling. Quality newspapers such as the "Times" afford virtually zero space to such matters. There is thus a drastic need for a cultural change—without this, minor adjustments of salary scales and structures are of no great consequence.
- Thirdly, as a consequence of the educational structure within this country, the majority of junior and infant school teachers are women, who have been educated in an era when very few women studied science and engineering at a high level. This means that from a very early age for most children, bias against science is quite strong and is reinforced in particular for women. The new National Curriculum begins to address this issue but does not go far enough. All infant and junior school teachers should have a working knowledge of Mathematics and Science.

Turning then to your specific questions on Acadenic Careers for Graduate Scientists within the cultural context outlined above, I would note the following in response to your seven questions:

(1) The career structure for Research Fellows simply does not exist—these are short term posts and only a few move on to academic positions. Most see Research Fellowships as a "stop-gap" measure, only few see it as an essential step to a lectureship.

(2) The growth in short term research contracts means, on the negative side:

(a) longer uncertainty for the contract researcher,

(b) a delay in employing highly trained people in industrial positions (although only a few exist),

and on the positive side:

(a) more qualified researchers working in academia,

(b) extra use of the scientific abilities of able people before they are lost to the parasitic world of accounting or the equivalent.

(3) Without a significant cultural change so that scientists are more highly rewarded by society then there will be little change. This is particularly true in the hard sciences where the number of able people wishing to study at degree level is limited and science departments are contracting in permanent staff members rather than expanding. If more able students wished to undertake science degrees and

there were more jobs at the end, then we would require more science lecturers and the system would not "bottleneck" as it does at present.

(4) The 10 contract researchers who have worked with me (over the last 10 years) have all continued in science, although only one has remained in academia (and that is a five year Postdoctoral post). Three have moved overseas to short term contracts, three now work for the Ministry of Defence, two work for Sharp and one for EPSRC.

(5) To increase mobility of scientists between academia and industry (why this should be beneficial is unclear to me since the two working environments are so vastly different) will need a significant increase in salary scales so that the inconvenience of moving is in some way compensated.

(6) The situation for women will only change when:

(a) the national culture towards women studying sciences changes,

(b) junior and infant school teachers become much more scientifically literate,

(c) there is a clearly defined academic path for all scientists, with junior posts being long term but with more serious hurdles to promotion, as for example in banking. This means that the system of Postdoctoral Assistants needs to be replaced by longer term research assistant posts followed by senior research assistants, junior lecturer, lecturers, etc, in the same institution. I don't actually believe such a system will work but without that stability the chances of returning to a permanent job in academia after some years out having children is very slim.

(7) The MRes scheme is a waste of time. It is ill-conceived. Any scientist going through a decent institution would not require this MRes degree. It looks like a hotch-potch measure to satisfy a few industrialists who seem to believe (where is the evidence?) that graduate scientists need further general training before becoming valuable to them. My senior colleagues in industry are of the view that the retraining required is given by the industry itself, satisfying its own particular needs. Of course it may be argued that some European countries have intermediate degree levels such as MRes but they also have a very different educational structure and scientists are much more highly regarded and better paid; thus young people can afford the extra year in training.

In our culture all the MRes will provide is a stop-gap again for those who have not made it directly into industry or research. Of course it is possible, by paying MRes students at a much higher rate than the fourth year MPhys or MEng students, that all the able students will be "bribed" into the MRes degree. This does not make it educationally sensible, it simply forces the issue.

Certainly in the context of trying to alter the short term contract research system the MRes only adds another damaging level. This is an extra one-year-only contract with no direct link to further career progression. Thus, in the context of this enquiry it has to be opposed. If it is seen as a requirement by some industries then they should fund it and encourage secondment of their employees to appropriate courses.

12 January 1995

Evidence from the Scottish Higher Education Funding Council

Thank you for agreeing to allow a few extra days for my response to the Sub-Committee's call for evidence on academic careers for graduate scientists. The Scottish Higher Education Funding Council has not specifically considered this issue in its entirety but aspects of it have been covered in discussions on the development of our policies.

Although the Council itself has gathered little direct evidence about academic careers—most of the sources which we would cite will undoubtedly have been drawn to your attention by their authors—anecdotal accounts of academic and research employment give some cause for concern. The Council has begun to address age structures and women's participation and is encouraging staff development policies in the institutions which it funds. The HEIs are being made aware of the concerns on academic careers expressed within the Government White Paper *Realising our potential.*

ACADEMIC CAREERS

The difficulties of the recent past in the higher education section led to an employment climate which has been characterised by frozen recruitment and promotion, limited opportunities for entry to the profession or progression within it and little stability. Where new employment opportunities have been available, there have been few permanent contracts. The posts that have been available have been supported for specific purposes, usually research projects. Therefore, while the greater part of the academic workload is concerned with teaching, the few footholds that have been available to aspiring academics have focused upon research.

Short term contracts

Short-term contracts encourage mobility and flexibility on the part of the employees and have advantages for the employers in terms of reduced commitments. The wide-ranging working relationships which are brought by a member of staff who has been employed in many other places may also be seen as an advantage. However, the highly competitive and unpredicable employment environment can militate against scientists remaining in academia. A lack of stable employment can lead to low motivation and to a search for alternative employment in a field which offers more secure prospects.

The need for the individual to maintain some continuity in employment can affect the conduct of science. Staff coming to the end of a limited contract may move if another job opportunity presents a longer horizon of work. As a result, projects may lose research staff before the work is completed. Where short-term contract staff have teaching responsibilities, there is a resulting lack of continuity for the students. The development of coherent and focused teaching courses, and thus professional skills, on the part of temporary lecturing staff may also be limited by short-term employment.

There is much force to the argument that the personal disadvantages of short-term employment are a disincentive to stay within academia. Personal difficulties can counteract any professional enthusiasms. Short-term contracts can lead to domestic upheavals, with moves being necessary every year or so. Mortgages are not always available to those on short-term contracts and the lack of employment rights together with future uncertainties may mean that child-rearing is not a feasible option. Few people are sufficently committed to give up prospects of family life for the sake of science.

Core funding

Short-term funding is inevitably related to specific projects. However without core funding of the kind provided by the Funding Councils, to enable at least some level of permanent employment of scientists, there will be no source of experienced staff to direct and carry out such work. Core funding encourages stability of employment. It enables institutions to maintain research groups and allow long-term investigation and understanding of issues which may not yet have demonstrated sufficient potential for project funding. New avenues of investigation can be developed in a way that goal-oriented project funding does not allow. Curiosity driven work provides a continual source of original ideas. Without these ideas short-term funding will have nothing to build upon and the science base will wither away. Short-term funding enables short-term effort, but does not encourage or enable long-term investigation and understanding.

Core funding is also essential to the production of future generations of scientists and thus to teaching within higher education institutions. There is a continual and tangible need for experienced teaching staff to provide an education for the students who attract core funding. The expansion of higher education has led to increased teaching demands on the existing academic staff, yet those who wish to pursue an academic career have limited opportunities to acquire or demonstrate these skills.

Age structure of the academic population

A symptom as well as a cause of the difficult academic employment climate, which has led to limited opportunities for aspiring academics, has been the uneven age structure of the permanently employed academic population. Expansion and large-scale recruitment in the 1960s and 1970s combined with cutbacks and redundancies in the 1980s and 1990s has led to a preponderance of staff within the 45-54 year old age group. This demographic "cliff face" has meant little natural wastage and the imminent danger of a sudden demand for experienced staff which could not be met. Reduced opportunities for employment lead to a reduced number of people who view an academic career as an option and the pool of candidates available when this demand emerges may therefore be limited.

COUNCIL ACTIVITY

Since its creation, the Council has been concerned to create a selective, yet stable environment for higher education, which maximises the opportunities for the full range of academic activity. The Council has endeavoured to distribute its funds by transparent, and therefore predictable, methods. In addition, to avoid large-scale fluctuations in grant from year to year, the changes which it has introduced, in moving to more rational funding systems, are being implemented gradually and total institutional allocations have been protected by a "safety-net" grant (set so as to avoid unmanageable changes in resources from the Council and from tuition fees). A predictable funding environment enhances the opportunities for strategic planning of all institutional activities, including academic employment.

Institutional strategic planning

The Scottish Higher Education Institutions produce annual strategic planning statements which are seen by the Council. These include commentaries on the institutional staffing strategies. The Council encourages the HEIs to develop these strategic plans with regard to the policy context of higher education, including the issues and objectives on academic careers emanating from *Realising our potential.*

New Blood scheme

The Council has attempted to help institutions address the difficulty of the unbalanced age structure through its "New Blood" scheme. This seeks to smooth out the age structure of the academic population by encouraging the premature retirement of staff aged 59 years or under and their replacement with permanently employed new blood appointees (see attached circular letter). This has created over 300 vacancies for permanent posts to be filled in Scottish HEIs during 1995 and an opportunity for the HEIs to restructure their scientific efforts according to current priorities. By reducing the number of staff in the older age group, the academic population should become closer to a more sustainable age distribution. As the bulges in the system disappear there should be more stable entry and exit from academic employment. Institutions were required to pay regard to the findings of the Lane report, *The Rising Tide,* in their implementation of the "New Blood" scheme and the council will monitor the gender balance of the appointments made.

Women in Science, Engineering and Technology

As the increased numbers of female science students work their way through to graduation and employment there may be an increased level of participation by women in the science base. However, the level of wastage at all stages is not expected to improve without initiatives to address the problem. Recent moves towards the development of more supportive teaching and learning methods, together with enhanced staff management and development strategies may have a beneficial effect upon retention. While issues of proper management of staff affect all employees, the area of anti-discriminatory practice has particular relevance to the employment of female scientists. A related issue is again short-term contracts which provide additional opportunities for discriminatory practices. The Council is currently in the early stages looking at options for initiatives to enhance access for women to science, informed by the findings of the Lane report.

MRes

The proposed MRes is directly relevant to the Council's concerns, but no policy has yet been articulated. The issue is being observed jointly by the Research Councils and Funding Councils through the Science and Engineering Base Co-ordinating Committee. There are, of course, peculiarly Scottish concerns about the proposals. The addition of another year of training must be considered in the context of the traditional four-year Scottish degree and the current proposals for the revision of secondary education within Scotland. However, the outcome of the pilot exercise is awaited with interest.

I hope this broad discussion of the issues raised in the Sub-Committee's call for evidence as they have impinged upon the Scottish Higher Education Funding Council is of value to their Lordships.

Professor John Sizer
Chief Executive

1 February 1995

Supplementary evidence from the Scottish Higher Education Funding Council

1. I refer to your letter of 27 April to Professor Sizer. Since Professor Sizer is out of the office this week on business, he has asked me to reply on his behalf.

2. I understand that you received from Professor Graeme Davies (Chief Executive of the Higher Education Funding Council for England) a technical comparison of the research funding allocation methods used by the Scottish and English Higher Education Funding Councils, so I will not go over this same ground. I have, however, set out below some of the rationale behind the Scottish Higher Education Council's present method for allocating research resources, together with the indications which the Council has given institutions about future funding. In a separate section, I have also provided a very brief explanation of the Council's method of allocating funds for teaching with particular reference to priority subject areas and rewards for excellent teaching quality.

Section 1—SHEFC'S Method of Allocating Funds for Research

3. The Scottish Higher Education Funding Council provides higher education institutions with research funding in the following way. About 95 per cent of research funding is distributed according to a selective formula based on the results of the Research Assessment Exercise, and five per cent is allocated to develop the research base according to a different, proxy measure of quality. In the main method, the available resources are allocated according to the formula described below: the phasing in of this method will be completed by 1996–97.

Main Method

4. In the first stage of the formula the total resources available to the Council are divided among the 72 subject disciplines which correspond to the units of assessment at the 1992 Research Assessment Exercise (RAE). This allocation is in proportion to the product V, C, Q, P, where the factors used are described below:

- V is indicator of the volume of research in the discipline—it is the number of academic staff active in research in departments rated two or more in the RAE;
- C is a cost factor, which in broad terms takes account of the relative cost of research in the discipline. Each discipline is assigned to one of three cost bandings. These represent laboratory-based subjects (high cost), intermediate or broadly based subjects (medium cost), and non-laboratory-based subjects (low cost);
- Q reflects the relative quality of Scottish research within the discipline as a whole in comparison with the Scottish average for all disciplines, using the outcome of the RAE;
- P is a factor which is intended to reflect the Council's priorities—it is presently dormant, but can be used to discriminate between different subject areas.

5. In the second stage of the formula the total for each subject discipline is divided among the institutions active in that discipline according to their share of v × q, where v is a broad indicator of volume or research and q is an indicator of the quality of the research in the department based on the RAE ratings as described below.

- the RAE ratings are transformed to produce q by giving a 40 per cent uplift for each single step ratings increase:

Rating q
1 => 0
2 => 1
3 => 1.4
4 => 1.96
5 => 2.744

- in this part of the formula the volume indicator v includes factors and weightings in addition to that used in V as shown below:

Factor	*Weighting*
Academic staff active in research:	1
Research assistants:	0.1
Postgraduate research students:	0.1
External research income:	0.000004 (=0.1 divided by 25,000)

(The external research income is that of departments rated three or more in the RAE, and division by 25,000 gives this factor broadly the same weight as research assistants and postgraduate research students. All of the sources of external research income are included, and a two year average.)

6. The resource allocation for an institution under this grant is calculated by aggregating the figures generated by the above formula for each of its departments. Institutions are told, however, that the indicative figures which the formula attaches to departments should not be taken as precise guidance in their internal allocation of research funds since, for example, their knowledge of the relative costs of research in various subjects at an institution might suggest a different pattern of allocation. This also acknowledges the fact that the RAE figures on which the formula is based are historical and may not describe the current situation in the institutions.

7. The formula is clearly selective according to quality. The advantage of using an exponential rather than a linear function to transform the RAE ratings is that it gives medium and higher rated departments the same incentive for improvement as lower rated departments. This selectivity has not been moderated in any way, as the Council has not "capped" its allocation after operating its allocation formula.

8. Looking forward to the period following the 1996 RAE the Council has indicated that its current view is that "the Council's main objectives are likely to include maintaining the unit of research funding for higher rated departments" and that "the resources available for allocation through its principal research funding method in recognition of the work of 2-rated departments may possibly disappear from 1997–98 onwards". This should encourage institutions to concentrate on building on their existing strengths, and should avoid dilution of the resources available through volume increases of lower rated research.

Pump-priming/development resources

9. About 5 per cent of the Council's recurrent funding for research is in the form a scheme to encourage pump-priming and development work. The size of each institution's grant is determined by the level of income for research that was obtained by its departments not rated three or more from all sources other than the Funding Council. This measure was chosen to reflect recognition of quality other than through the RAE, through customers for research outputs. The funds are not intended to subsidise research for commercial customers, but should be used to encourage research development. In order to ensure that this occurs, the funds are released to the institutions on the submission of acceptable institutional strategies for their use. This particular grant scheme was for three years and is due to finish in 1995–96, but the Council has indicated that it wishes to retain thereafter an element of funding based upon criteria other than the RAE.

Section 2—SHEFC's Method of Allocating Funds for Teaching

10. The Council's main grants for teaching are determined by applying standard units of teaching resource to student places to be funded. These two factors are explained in more detail below:

- The Council allocates a number of funded places to institutions in each of a number of broad subject areas of provision. For the main subject areas, funded student places are allocated in a manner which takes into account evidence of efficiency of delivery and student demand. There are also controlled subject areas (such as medical education and teacher education) where funded student places also take into account central government planning considerations for the professions concerned.
- The units of teaching resource take into account in a broad manner the differences in costs between different subject groups. This approach is not intended to take into account detailed cost differences between individual courses or between different institutions. The Council has made it clear that institutions are expected to exercise their own judgement regarding their allocations of these resources internally.

11. Against the background of Government seeking consolidation in overall student numbers, the resources available to support additional funded student places has been limited in recent years. Despite this, the Council has given priority to science and technology through funding additional places in the subject areas of science, engineering, mathematics and computing. This has resulted in significant increases in provision in these subject areas as a whole in Scottish higher education institutions.

12. The Council also explicitly takes the quality of teaching provision into account in its funding by using the results of its teaching quality assessment. Institutions where teaching provision in a subject has been rated as excellent are rewarded by the provision of 5 per cent additional funded places in the subject concerned. In cases where teaching provision in a subject is assessed as unsatisfactory, the institution is warned that funded student places may be removed in the subject area concerned unless remedial action is taken.

13. I hope that the information set out in this letter is of assistance to the Sub-Committee in its deliberations. Full details of the Scottish Higher Education Funding Council's funding methods are to be found in the Council's main recurrent grant announcement in Circular Letter 10/95, a copy of which has been placed in the House of Lords library. If you require further clarification of any points, please do not hesitate to get back to me.

David Wann
Director of Funding

12 May 1995

Further evidence from the Scottish Higher Education Funding Council

I am writing to make a number of comments on the draft minutes of evidence of the hearings of the above Sub-Committee, held at the Royal Society of Edinburgh on 25 and 26 April 1995.

It is somewhat surprising that a sizeable proportion of the evidence heard by the Sub-Committee was directly related to the Research Assessment Exercise (RAE) and the funding methods of the Scottish Higher Education Funding Council, and yet the Council was not asked to give evidence on these matters. (The Council appreciated the opportunity to give evidence to Lord Flowers' recent House of Lords Sub-Committee on Priorities for the Science Base, for which the RAE and the Council's funding methods had some relevance.) Unfortunately, the omission of Council evidence appears to have allowed a number of misunderstandings to arise during the hearings so I hope that these comments, together with the letter of 12 May to you from the Council's Director of Funding David Wann, will go some way to improving the factual accuracy of the Sub-Committee's eventual report about matters relating to the Council.

The misunderstandings were given clearer expression in the second hearing at the Royal Society of Edinburgh than they were at the first, so I will comment on that transcript first.

Wednesday 26 April 1995

Question 956: the phrase "five minues one" refers to the transformation of the RAE rating used by the Higher Education Funding Council for England to achieve a measure of quality. This transformation is not used by the Scottish Higher Education Funding Council: the RAE rating of 5 is converting into a quality weighting of 2.744 rather than 4.

Response to Question 996: it is said that the money related to the teaching function can be extremely variable. Most funding for teaching is allocated by formula based on the number of funded student places the previous year with marginal changes, and therefore has stability built into it. So far the Council has used safety-netting so that no higher education institution has large reductions in its grants for teaching and research from one year to the next.

Response to Question 1015: "high quality juggles" should perhaps read "high quality journals". In looking forward to the 1996 RAE the physics panel will publish the criteria it intends to use in advance of the RAE, probably in the autumn of 1995.

Response to Question 1017: it is stated that in the formula the same weighting is not given to research grants obtained from industry as to research grants obtained through Research Councils. This is inaccurate. The position regarding the Scottish Higher Education Funding Council is that the formula gives equal weight to all external sources of research income. The subsequent claim that the Council has put forward a specific argument in favour of differential weighting is as a consequence clearly wrong.

Response to Question 1021: this Council is the only Funding Council to have said that its main objectives are likely to include maintaining the unit of research funding for higher rated departments and that the resources available for allocation through its principal research funding method in recognition of the work of 2-rated departments may possibly disappear from 1997–98 onwards.

Response to Question 1023: the Council's research funding is selective at the level of the subject disciplines within an institution rather than at the level of the institutions themselves.

Response to Question 1026: It is again wrongly assumed that the assessment of the quality of research demands a high volume of publication, so the supposed consequence of this that is explored cannot be attributed to the RAE. The Funding Councils made it clear in 1994 that for the next RAE the volume of research will not be requested from higher education institutions. It is therefore wrong to say that "if one [research centre] produces twice as many publications as the other you have to say that it is better".

Response to Question 1029: for the misconception that "volume indicators such as volumes of publications are so important" in the RAE, see above.

Response to Question 1031: The Chief Executive's Research Advisory Group provides independent advice which feeds into the deliberations of the Council—it is not a committee of the Council. Its members are from the academic community and have considerable experience of research and research management.

Response to Question 1050: it may perhaps be said that interdisciplinarity is an area in which research assessment exercises failed in the past, but it is an area to which the next RAE will give close attention. I refer you to the Circular 1996 Research Assessment Exercise (ref RAE96 1/94) which explains how interdisciplinary research will be handled. A submission to a unit of assessment may suggest other units of assessment to which it should be referred, and panels will be instructed to give full attention to the special nature of interdisciplinary research and of its assessment. In preparing for the 1996 RAE have consulted widely amongst higher education institutions, so that any lessons from the 1992 could be taken on board.

Tuesday 25 April 1995

Response to Question 850: the reference to a timescale of two weeks is false. Broad guidance was published last year, and detailed guidance will be published in the autumn of this year, which is months before submissions are due. The published series of RAE circulars contain the timetable.

Response to Question 862: funding for research is expected to be used broadly for research.

Response to Question 864: it is not the case that "the first time round the Scottish Funding Council used a formula which it did not like" and it did not say it "could not think of anything better". Rather, in the grant letter for 1993–94 it said that due to lack of information it would rely, in the short term, on the historic pattern of funding to subject areas. The new funding method, introduced in part for 1994–95, will be fully phased in by 1996–97. It is unclear to whom "they" in the third sentence of the response refers. If it refers to the Council then it is wrong—institutions are broadly free to make up their own unit of resource. The "issue" referred to in the final sentence is a matter for institutions themselves.

I hope that these comments will be of some help to you in finalising your report in due course.

Professor John Sizer
Chief Executive

25 May 1995

Evidence from Shanks & McEwan (Southern) Ltd

I have been made aware of the Select Committee's call for evidence in relation to academic careers for graduate scientists through my role on one of the committees of the Geological Society of London. The matters raised in your questionnaire are of interest to this company in relation to its research and development programme. We have not answered all of the questions raised and the numbers below reflect those in your questionnaire. My role in the matter is as manager of the company's solid waste-related R&D programme and as a visiting professor at the University of Paisley.

2. As far as we can see the growth in short term research contracts is being balanced by a reduction in established research positions. The result appears to be some level of concentration on projects which are likely to be finished in relatively short periods of time and, because of a feeling that positive results will give greater benefits in future "job" hunting, a tendency to select research which will lead to relatively predictable outcomes. For companies such as Shanks & McEwan who prefer to purchase their research from the university sector this has two disadvantages:

(i) Some chains of research are likely to last for relatively long periods, up to 10 years in some instances, because of the nature of the matters being dealt with and so continuity can be lost; and,

(ii) even where the chains of research are not themselves continuous the loss of experienced researchers to other establishments can delay or impede further studies

It is recognised that the move towards short term research contracts is by no means the only cause of this type of difficulty but the additional effect is beginning to be noticeable despite the relatively restricted amount of research that we purchase.

3. In view of the current age structure and the fact that the change to short term contracts is still not mature we can only expect the situation to change for the worse in the next decade. How this will affect our programmes we are not sure. We find real advantages in placing research with universities provided that we can supply adequate management time, etc; the fabric of these benefits should not be destroyed for the sake of accountancy. We do not believe that we could obtain the same benefits if we tried, or were able, to emulate medium term tenured posts in the placement of research contracts.

4. We have no data on the destinations of scientists leaving the research sector. The effect of such loss, however, is a need to develop new partnerships. This can be valuable, for that reason we try to do so, but it can also lead to loss of headway on multi-stage projects while expertise that has been lost to the system is redeveloped. (Losses to competitors are part of life and there is inevitable flowback in any case; straight loss is more damaging because it is loss for the industry as a whole.)

5. We believe that there would be significant advantages to all concerned, in our industry at least, in a three way secondment system involving industry, regulators and academia. The basis for this is that there is a very real need for these three sectors to understand each other and each other's position and requirements. Such a system would have the advantage of making the academics concerned more attractive to the industry and its regulators and this in turn would place recent research knowledge inside the commercial structure—ie, the results of recent research would acquire additional chances of being absorbed into a commercial activity.

6. It is to be hoped that women will find careers in science, engineering and technology both easier to enter and more interesting in the next decade. It is notable that the proportion of female graduates in the areas in which this company operates seems to be increasing, especially in topics related to environmental engineering and environmental technology. The trend has been noted both in direct applications for these types of post in the company and through universities for research contracts. So long as the candidates are of equal calibre we will be happy to take on whoever best fits the requirements of the post—60 per cent of the PhD students that we fund at present are female. In the end, however, it is the quality of the candidate that is important rather than the sex; the long term impact of poor-quality research or operations on the environment, in our industry at least, can be very great.

On the basis of the above we believe that scientific careers should not need to be made more attractive to women, or to any other sector of society. What appears to be at fault is the way that the relevant subjects are taught in secondary and even primary schools. There is no doubt that the nature of the short term contracts available and the poor standard of living of those that take them up makes them unattractive but that should apply equally to both sexes.

We feel that the question should be rephrased to ask what should be done, and at what stage during the process of education, to make the appearance of science, engineering and technology as attractive to women as to men and what should be done to make careers in these disciplines attractive to high quality candidates.

7. The MRes degree scheme appears to be completely worthless. The degree of MPhil forms a perfectly adequate base or a PhD where it is felt that such a base is needed at all. The only results of the introduction of the new degree are likely to be:

(i) additional administration with a resulting loss of yet more money from the science, engineering and technology that is supposed to be the aim of the research sector; and,

(ii) further confusion and reductions in morale amongst students and academic staff alike.

This is a nonsensical scheme; we would be pleased to see it dropped.

Unfortunately we did not receive notice of the Select Committee's questionnaire until very late in the day and we have not had time to consider matters beyond those raised by the Sub-Committee. We hope that our opinions above may be of some use to the Sub-Committee. Please do not hesitate to contact the undersigned should you require any additional information or clarification.

J B Joseph
Chief Hydrogeologist

16 January 1995

Evidence from Professor F J Smith, School of Electrical Engineering and Computer Science, Queen's University of Belfast

The following is in response to your request for a response to the questions in the House of Lords' "Call for Evidence".

(1) *What are the problems and advantages of the current career structures for academic scientists in the UK?*

The main problem is that our salary scales are the same as our Arts colleagues, although the amount of work required by a dedicated scientist or engineer is much heavier. Also, unlike the United States it is not easy to obtain extra money from research contracts.

(2) *What are the advantages and disadvantages of the growth in short-term research contracts in academic science?*

One advantage is that unsuccessful research does not waste more money. The disadvantages are few, since a good researcher can always obtain further funding if previous research has been successful.

(3) *How do you expect the situation to change in the next decade?*

Because the remuneration of highly successful scientists and engineers does not match what is available in industry, the number of really talented people doing academic research will fall in this country. This will have long term effects on the international competitiveness of our industry.

(4) *What information do you have concerning the destinations of those scientists who have left the contract research sector of academic science?*

I have conducted no survey, but those whom I know have either moved into academic life or moved back to industry, probably on a 50:50 basis.

(5) *What should be done to improve the mobility of scientists between academia and industry?*

The American system which encourages academics to obtain extra income from industry, typically on a one day per week basis, enormously improves the transfer of knowledge between industry and universities.

(6) *How do you expect the situation concerning women in science, engineering and technology to change in the next decade?*

No change.

What should be done to make scientific careers more attractive to women, and how?

Make the demands of the jobs less onerous.

(7) *The Government's Master of Research (MRes) degree will be piloted from late 1995. Please outline your assessment of the growth of this scheme.*

It is true the education of our scientists and engineers is in general too narrow. These extra courses at postgraduate level might improve this. It is likely that there will be a tendency for subjects to introduce even more specialised courses in their own disciplines rather than allow a broadening of the education of their students.

5 January 1995

Evidence from Professor M Springford, H H Wills, Physics Laboratory, University of Bristol

In response to the Call for Evidence I have consulted with my colleagues and should be grateful if you would convey the following views to the Sub-Committee.

1. CURRENT CAREER STRUCTURES

One advantage of the present arrangement is the short PhD which gives a young person one last opportunity to reconsider the decision to become a professional scientist. At 25 one can still walk away from a scientific career without being a failure, in a way that at 30 one cannot. A bad feature of the current system, however, is the postdoctoral arrangement. Having successfully obtained a PhD, and having decided to continue, a young scientist should have more freedom to blossom out and try new things. At the moment he/she has very few opportunities to do that. It is not that postdoctoral positions are too few, but rather that they are the wrong kind, being too focused. For the "high Flyers" three to six years fellowships are desirable, along the lines of the Royal Society University Research Fellowships.

2. WOMEN IN SCIENCE

I expect a significant increase in the number of women who would want to, and would be qualified to, pursue a scientific career. However, the question will be, can they combine child rearing with it? For the present, this problem resolves itself one way or other (no children, family support etc) but for a larger fraction of women significant changes in the way we do things are needed.

3. MRES/MSCI

I shall not reply to this important issue as the Institute of Physics and Standing Conference of Physics Professors has already expressed the view of the profession and will, I understand, make a submission to you.

4. AGEISM

At present, restrictions exist that prevent some research grants being awarded to people above a certain age (usually 35 or 40). These originated in days when good researchers usually obtained permanent academic positions in their twenties or thirties. Now, when contract research has become common as a permanent career (especially in medical research where permanent academic non-clinical positions are very rare) it amounts to a form of age discrimination. To be told, at the peak of one's scientific productivity, that one is ineligible for further funds simply because of age, has no scientific or other justification and can be painful. It can be particularly hard for women who may have started research late, or interrupted it for family reasons.

I should like to see the removal of all age restrictions on grant applications. Nothing can be lost: selection committees would retain their freedom to choose young and promising candidates, fresh to research. And much would be gained, by availability of highly skilled and versatile people of proven ability and with wide experience. The only disadvantage I can foresee is a slightly increased workload for the selection committees.

13 January 1995

Evidence from Unilever plc

INTRODUCTION

Unilever has a long standing belief that its products benefit from sustained research into relevant fields of science. This has led us to build and maintain two large research laboratories in the UK (at Port Sunlight in Merseyside and Colworth House in Bedfordshire).

We employ a total of 2,300 people in our UK research facilities and in addition we have collaborative programmes with circa 60 universities in the UK. Many of our Research Scientists are well known in academic circles and several hold honorary professorships in UK Universities.

Our interest in the academic career structure is determined by:

- our need to recruit well-trained scientists at PhD and post-doctoral level
- an occasional need to recruit mid-career research managers from Universities
- access to University departments for collaborative programmes
- using established academics as consultants.

GENERAL COMMENT

It is our general experience that newly-recruited UK scientists at PhD level are less proficient that their US or European peers in four areas:

- awareness of the commercial environment
- running research teams
- breadth of interests and research horizons
- basic experimental research skills.

In contrast we find the attributes of senior academics in the UK to be among the best in the world.

RESPONSE TO SPECIFIC QUESTIONS

1. We believe the current academic career structure produces capable mid-career researchers. We particularly note the flexibility that makes it relatively easy for such scientist to work with industry from an academic base.

However, we find the output at PhD and immediate post-doctoral levels to be poorly trained by best international standards. In addition, many of our academic colleagues complain frequently to us that a great deal of their time is consumed by administrative work that detracts from both research and teaching.

2. In our experience short-term research contracts in isolation are not effective. We prefer to build relations over a period of years with individual academics who understand the complexities of research in our industry and can contribute strategically.

Commercial reality, however, dictates that such a relation is built by a succession of relatively short contracts.

3. It is our intention in the next decade to increase our involvement with academia across the world. This will take the form of three main thrusts:

- greater use of academics to manage our internal resources against agreed research targets
- formation of consortia of industries and Universities to research basic areas of relevant science
- increasing our involvement with academics outside Europe and the US.

4. No relevant information available.

5. As indicated above we believe there is considerable merit in establishing long term strategic alliances based on well briefed and defined research projects. This will provide opportunities for academics with relevant skills, abilities and interests to combine an academic and industrial career. We have started to experiment, in a small way, with the appointment of a few well-respected academics to lead internal research projects with clearly defined responsibilities and access to internal resources. Reducing administrative loads on active, able researchers in Universities would help to facilitate this development.

In addition, we have had very positive experience of the European Union Human Capital and Mobility Programme.

6. We are committed to increasing the number of women in management generally and have made significant changes to our recruitment and employment practices to facilitate this. In 1988, women made up only 9 per cent of our total management numbers in the UK, in 1994 this figure had grown to 19 per cent and we expect this figure to continue to grow over the next decade. However, the Technical function lags behind the rest with women making up only 14.8 per cent of our UK Technical management.

This is a complex area with no simple solutions. However, we believe that much more needs to be done at the early stage of career choice. Over the last five years, Unilever has actively sponsored a Science workshop for sixth form girls with St Hilda's College, Oxford. Our experience is that such workshops can do much to boost self confidence at a critical stage in career choice.

7. Professor R B Leslie on behalf of Unilever made a detailed submission to the Office of Science and Technology (22 March 1994) on our views on the proposed M Research qualification.

In essence, we do not believe the proposed one year M Research qualification will add real value to an uprated PhD. Drawing on our European and US experience, we would advocate that the proposed UK four year PhD should include in addition to guidance in the methodology of research, and a meaningful period of independent research, specific advanced course work in both scientific and non-scientific topics.

Evidence from the University of Strathclyde

1. PROBLEMS AND ADVANTAGES OF CURRENT CAREERS STRUCTURES FOR ACADEMIC SCIENTISTS IN THE UK

Three phases can be identified in the career of an academic scientist:

(a) Apprenticeship phase

— postdoctoral research assistants, new lecturers.

(b) "Mentored originality"

— first steps in creative original research, supported by scientists with greater experience, including submission of bids for research contracts.

(c) Established scientist

— sound track record including promotion, academic distinctions, research consultancy and commercial exploitation of research.

Different career issues arise at these various stages:

(a) Apprenticeship phase

The availability of numerous short term contracts permits many PhD scientists to enter research. A study by the Institute of Manpower Studies[1] estimates that approximately one third of PhD graduates in core sciences enters employment in higher education. This may be offset by lower salary levels than in industry, but there is currently no difficulty in attracting highly qualified entrants at this level.

Personal issues such as the insecurity associated with short term contracts are generally not of major importance in a first appointment, but if this is followed by a series of similar contracts (sometimes renewable on a monthly basis) this can lead to a loss of motivation and productivity as the researcher or temporary lecturer may find it difficult to focus full attention on the work in hand.

(b) Mentored originality

This concept conjures up the ideal situation in which the developing scientist is nurtured within a supportive scholarly environment. The Universities Staff Development Unit's paper on continuing professional development for staff in higher eduction[2] has identified such instances of good practice for staff development in higher education institutions. All too often, however, the competitive environment in which research bids are prepared creates pressure on individuals which curb collaboration and leave scientists at this level feeling that the institution has no interest in their professional career development.

It is at this stage that academic scientists are liable to become discouraged for a variety of reasons including lack of evident support from their managers, lack of funding for state of the art equipment, salaries which are low relative to those in industry and often the continuing insecurity of short term contracts at a point in their lives when they may have acquired more personal commitments.

(c) Established scientists

For individuals who continue to attract funding in research areas which are designated centres of excellence, this is the prime of their career. As institutions target more rigorously the subject areas which they wish to develop as top priorities for investment, other disciplines will become eclipsed, thus running the risk of making other experienced scientists feel disadvantaged in their future research and career prospects and undervalued by their institution.

There may also be a dilemma about how to develop a long term career in higher education. Most academic institutions do not give comparable rewards for teaching, research and academic management. An individual seeking advancement and the possibility of a permanent contract may therefore opt for an area of work which is not a natural strength.

2. ADVANTAGES AND DISADVANTAGES OF SHORT TERM RESEARCH CONTRACTS IN ACADEMIC SCIENCE

Some increase in short term contracts is inevitable for financial control in an environment in which the Government requires still more efficiency gains on top of the substantial achievements of the last 10 years. It is essential to retain enough flexibility to manage the system within cash limits. This can create problems, however, for individual scientists and universities.

Depending on the nature of the contract, short term contract staff may not be eligible for either sick pay or paid leave.

Short term contract staff are often overlooked when it comes to staff training, appraisals and career development. Apart from the negative effect on the individual, a recent CBI report[3] warned of the likely repercussions of this lack of investment in employees:

> "[This could] weaken the UK's skills base if employers are less likely to take direct and long-term responsibility for employees who are not at the "core" of the business".
>
> Short term contracts make it difficult for staff to maintain a high level of motivation and commitment to the institution, which ultimately has a deleterious effect on the momentum of the institution's drive towards its goals.

It would therefore benefit both individuals and institutions if short term contracts stated a commitment on the part of the employer to provide continuous professional development. Despite the emphasis which most professional institutions are now placing on continuous professional development, the Employment Minister[4] has recently stated that "People are responsible for their own futures." At one level that is a reasonable statement, but it can be used by employers as an opt out clause and is at odds with the Investor in People philosophy which emphasises the employer's obligation to facilitate staff development.

3. Projected changes

The CBI has predicted[5] that by the year 2000 it is likely that only half of the UK's workforce will be in full-time, permanent employment. Although this trend will have greatest impact on unskilled and semi-skilled "flexible staff", there is no reason to believe that higher education will be an exception to the widespread structural changes in the labour force, resulting in a small core of highly qualified professional staff with permanent or at least long term contracts and an army of contract staff who will be employed as the need arises.

The opportunity for institutions to move in this direction will arise as staff appointed during the mass expansion of universities in the 1960s approach retirement age. The necessity to accelerate this trend will be driven by the short-term availability of an increased proportion of institution's funding and the need for stringent, cost-effective resource management in a continuing climate of efficiency gains. The main effect of this trend will be to make it more difficult for people to reach the established scientist phase of an academic career.

4. Destinations of short term contract scientists

There is no comprehensive statistical information on scientists who leave short term contracts for alternative work. The first destination statistics compiled by university careers services refer only to the destinations of first and higher degree graduates at 31 December in the year of graduation. These statistics have been analysed in depth in "The Demand for PhD Science Graduates", but they do not throw light on the later career development of academic scientists.

Such information could be collated and analysed in a commissioned research project using the following sources of information:

> Questionnaires on career progression issued by appropriate professional bodies to their members.
>
> Exit surveys/interviews conducted in conjunction with university personnel departments with a sample group of academic scientists whose contracts have recently expired.
>
> Consultation with a sample range of employers of scientists about the previous occupations of entrants over the last five years.

A major problem for academic scientists leaving short term contracts is a lack of access (or perceived lack of access) to professional careers advice. Many university careers services, because of lack of resources, do not regard graduates of some years' standing as part of their normal remit. With a modest amount of additional funding, careers services could be resourced to offer mid-career counselling to scientists (and other highly qualified staff) nearing the end of their contracts.

As a way of tackling this problem the University of Strathclyde Careers Service piloted a career development course for short term contract staff. This model was subsequently adopted by the Careers Services in Edinburgh and Heriot Watt Universities. There is scope for the further expansion of this kind of practical help for short term contract workers.

5. Mobility of scientists between academia and industry

Contacts between academics and industrial scientists are already good in most fields. This contact is facilitated by collaborative projects supported by both industry and the public sector and by the appointment of industrialists as visiting professors in higher education institutions. A significant number of academics migrate into senior positions in industry. If it is felt desirable to improve movement in the other direction, it is necessary to provide funding to enhance the comparative level academic salaries and the available research facilities.

The inclusion of industrial placements, visits and case studies in industry in the curriculum of undergraduate science and engineering degrees and in the proposed MRes degree should be expanded. This would ensure that when science and engineering graduates are subsequently making a career choice, they are doing so upon the basis of first hand knowledge of the working environment in both industry and universities. This would also address employers' complaints that graduates lack familiarity with the demands of the workplace[6].

6. WOMEN IN SCIENCE, ENGINEERING AND TECHNOLOGY

The "nature *v* nurture" debate has not been conclusively resolved, but there is general agreement that encouragement of girls to consider a career in science and engineering should begin in primary schools. The work of the University of Strathclyde's Science and Technology Forum with Scottish primary schools is one example of good practice in this field.

The example of female role models portrayed through insight courses on women in science and engineering for school pupils and tutoring schemes which match undergraduates students with secondary school pupils have contributed to the rise in women students in most technological disciplines although there is still scope for improvement in the physical sciences, computing and engineering.

It is at the next level that women role models become more scarce. Women research assistants in the "apprenticeship" phase of their career do not see many women ahead of them in the next stages of an academic career. The few who have reached senior levels in these fields may have limited time to devote to the encouragement of younger women scientists because of the pressure of the common perception that in order for them to succeed in non-traditional career areas women's performance must be exceptional. Many are also simultaneously coping with child care and home commitments for which ther is little support either in the community or among employers. Adequate child care provision is a legitimate cost if the Government is consistent in its view of the importance of increasing the female participation rate in science and technology.

Another impediment to women's career development in science is the damage a career break can do to the classically acceptable cv. A career break tends to curb activities such as the publication of scientific articles, attendance at conferences and experience of bidding for research contracts. Thus male and female applicants of a comparable age for an established or promoted post may not have equal amounts of experience. Unless practical support to working mothers is provided so that career breaks may be shorter or a more sympathetic attitude is taken to the effect of a career break on a cv, then it is difficult to see a marked improvement in the proportion of women continuing to higher levels of a career in academic science.

There is scope for encouraging mentoring schemes to assist young women scientists in the early part of their career, but credit for such involvement should be given to experienced mentors so that their own career prospects are not adversely affected by the time which they devote to such activities.

Proportionally more female than male staff in universities are on temporary and part-time contracts, some of the features of which may be an adverse effect on women's careers. Policies and mechanisms should be adopted to ensure that such part-time research staff should be eligible to hold Research Council grants without discrimination and to supervise students for research degrees so that scientists who need a flexible interval are not debarred from the development of a research career.

7. MRES DEGREES

The MRes scheme usefully identified a number of training issues tht are important for bringing up researchers. However the Government failed to understand the role of PhDs in many vital industries (the Pharmaceutical industry[7], for example) and the reality that many of its objectives in the REes scheme were already in place in existing undergraduate and postgraduate courses. The mistake has been compounded by the change in rules of the game now emerging as research councils try to implement something that is reasonably close to the MRes concept put forward in the White Paper. SHEFC was not excited by the plans, being unable to find additional funded places, and industry and HEIs did not like the implied reduction in the PhD output in a cash limited economy. A pilot study is probably sensible academically to test the concept from the point of view but at this stage, the scheme runs the risk of being stillborn. There may be more integrated and more cost effective ways of developing the issues raised about research training in the White Paper than setting up new schemes.

References:

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2. Continuing Professional Development for Staff in Higher Education: Informing Strategic Thinking, Universities Staff Development Unit, due to be published early in 1995.
3. Flexible Labour Markets: Who Pays for Training?, CBI discussion paper, 1994.
4. Quotation from Mr James Paice, employment Minister, at the launch of the above CBI paper. Cited in *People Management*, January 1995, p19.
5. Op cit.
6. Graduate Salaries and Vacancies, annual report, association of Graduate Recruiters, January 1995.

7. Response of the Association of the British Pharmaceutical Industry to the OST Consultative Document on the MRes degree, May 1994.

Evidence from Dr Tom Welton, Department of Chemistry, Imperial College of Science, Technology and Medicine

Thank you for the invitation to meet you on Tuesday 13 December to discuss academic career opportunities for young scientists. Unfortunately, time did not allow for a thorough discussion of our ideas as young academics. I am, therefore, writing to expand on the points that I would have liked to have covered given more time.

First my career to date; 1988–1991 post-doctoral research fellow, University of Sussex; 1991–1993 Demonstrator in Inorganic Chemistry, University of Exeter; 1993 to date Lloyd's of London Tercentenary Fellow, Imperial College; to start October 1995 Junior Lecturer, Imperial College. In terms of my ambition to become a university lecturer, this can be seen as a success, and my comments should be seen in that light. Someone who had failed in that aim may have very different views.

Both the job as Demonstrator at Exeter and as Lloyd's of London Tercentenary Fellow involved considerable teaching loads, certainly sufficient to have an impact on my research. As a Demonstrator, the teaching was part of the job, but as the Lloyd's of London Tercentenary Fellow the teaching is a "favour" to the department. Since I believe that the teaching experience that I gained helped me to be appointed as a lecturer, I am happy to have done it. However the majority of contract researchers who take teaching responsibilities do not achieve this end. Therefore, in addressing this question, the primary question is that of career prospects.

The employment situation in university chemistry departments is that there is an approximately static number of permanent lecturing posts whilst there is a growing number of contract research positions. The number of research posts already outnumber the number of lecturing posts. The current trend (although this may change) in employment for scientists is that the traditional employers are decreasing their in-house research and increasing contracting out to university departments. This will lead to an even greater disparity between the number of contract research and lecturing posts in university departments.

It is no longer realistic to assume that all of those employed as contract researchers will simply become the next generation of lecturers.

Accepted wisdom within departments is that taking post-doctoral positions generally reduces your future employability in industry, unless you gain some very specific skills or knowledge of interest to a particular company. This may or may not be true, and is a question for industrial employers. Although a number of people will take a one post-doctoral position for a wide variety of reasons, the vast majority of those who take second positions (in chemistry) appear to be aiming at academic careers.

The final problem facing these people is that, as they get older, they find it increasingly difficult to get university sector employment. This arises as they get increasingly expensive to employ in comparison to younger colleagues.

It is clear that it will not be possible to generate a large enough number of lectureships to solve the problem, and other solutions must be sought.

Can people who have held contract research positions in universities be made more attractive to prospective employers, so increasing their ability to compete for jobs in other sectors. This would probably involve training in areas outside science that employers consider important, management skills, team-building budgetary control etc. Any such scheme would have to be compulsory or take-up would be low. It is unlikely that any other influence can be exerted on outside employers. Hence a solution within the university sector is required.

It is a fallacy to believe that people follow preset career plans with any precision, and this should not be over-emphasised. The important point is that there is the opportunity to develop a career.

It is initially useful to look at the various forms of funding for research posts. Those are industry, and government of which some funding is directed at projects (eg EPSRC grants) and some directed at people (eg NATO Fellowships).

Within the current institutional structure, industry may provide a few philanthropic fellowships that might be directed at people, but most of its funding will be directed at specific projects. At any one time this form of funding will probably employ most researchers. However it offers the individual employee no security and little opportunity to develop his/her career in an ordered manner.

Government funding directed at projects is essential to ensure that this form of work continues. Again this form of employment is temporary. One possible solution is to impose constraints of who is employed, for instance to ensure that people currently working in an institution are given priority. This is probably not a good solution, since project managers need the flexibility to appoint their preferred candidates, and it is unlikely to appeal to the current government. Casually, internal candidates are probably already at an advantage.

Currently, government funding directed at people is aimed at a small group of people for fixed periods. Junior recipients of these fellowships are people who are expected to progress to academic careers and are seen as lecturers in waiting. Older recipients are successful academics who are buying themselves out of teaching for some period. These links between this form of funding and the academic career structure can be broken. It should be possible to have schemes that could span the entire career structure, so that people can go from junior research fellowships when young, through an intermediate level and on to senior positions whilst always having a principally research career. Transfer between the two career paths should also be made possible. It will be necessary, however, to ensure that these schemes do not just become mechanisms for "the great and good" to patronise their favourite people or subject areas.

Another possible solution is that when applying for research project grants, the bar on applying for one's own salary is removed. This will break the reliance of contract researchers on their supervisors for generating their salaries. This will also be academically a good thing, given that the number of people with long-term research experience in the system will increase, it allows their ideas to enter the scientific discourse more readily.

Whilst these could both involve entirely new schemes, with new funding, neither of them necessarily involve spending implications, and some improvements can be achieved by redirection of current funds.

One of the major problems facing the whole university sector, and more experienced researchers in particular, is the age-related pay scales. This structure must be dismantled if long-term research careers are to become common. It will also have advantages in other areas. People must be paid for what they do and not for when their date of birth happens to be. The current structure creates tensions at both ends of the scale. Younger workers feel exploited because older people with no greater experience or skill, and sometimes less, earn more and many older workers become priced out of the market. Many grants are made with age limits. As careers develop people will achieve higher status as researchers, with attendant increases in salary and funders will see that workers cost more because they have greater value for the project and so are worth more. The government must stop all age limitations on its grants immediately.

This change may or may not have significant spending implications and would have to be costed.

If there is to be a major change in the university career structures new money will probably be needed. Whilst one can ask the government, it is unlikely that monies would come as "more of the same". Much will have to come from private/public collaboration. It is notable that those industries who are the greatest supporters of basic science at universities, such as the drug companies, are our most successful. Others must be convinced of this, as must the government itself. Collaborative ventures, perhaps growing out of the IRCs, in areas of basic science could provide a large number of employment opportunities for scientists in the university sector. However, it is essential that those subject areas that are successful in attracting this kind of funding are not penalised in other types of government funding. This is already evident in science funding.

I hope that you find my comments of some use.

SUMMARY

My own experience of being a young academic scientist is related. The problems facing young academics are set in the context of employment and funding trends over the past few years and some possible solutions are suggested. These include changes in the way in which grants are allocated and the pay structures of academic workers.

Evidence from Marion J A G Wooldridge

RATIONALE FOR SUBMISSION

This submission is intended to complement the clear, impressive and thoroughly researched evidence on the position of women in science and technology already submitted to the sub-committee by Dr Joan Mason.

It combines my opinions on points relevant to the position of women scientists with support provided by examples that have been related to me within the last three to four years, in my investigations into equal opportunities for women scientists.

I am not, on this occasion, representing anyone other than myself; examples have been gathered from a wide variety of different scientific workplaces, but I believe all of them typify general phenomena and attitudes.

3. SUBMISSION: AREAS FOR CONSIDERATION

3.1 *Assumptions and stereotyping*

Women's expectations of themselves

Generally, I think women still expect to progress less far in their chosen careers, both for practical reasons, and because of the "glass ceiling" effect. Many women have told me they feel there is little they can do about it, and that the stress involved in "fighting the systems" is not worthwhile. They feel lucky to have a job at all. This can only be altered by changing organisational culture.

Men's expectations of women

Some men still feel that women prefer to/should undertake the less challenging areas of work.

Example: A woman with clinical qualifications and a research doctorate was given the more routine tasks in a research project—with the explanation that they would suit her, because she was a woman. Although furious, she felt it would badly affect working relationships if she took the matter further. Subsequently, she said that from loving her work, she came to hate it, and now only works part-time, and she would prefer not to have to do even that. She is not in a position to relocate.

The "macho" science culture of total dedication

This culture is often very pronounced in research laboratories, with the assumption that serious scientists will not only work very long hours, but be prepared to attend at any time. Clearly, this is not reasonable for either men, or women, if they are to maintain any family or home life. It is also not borne out in practice; men may be away at meetings, or giving lectures, or even taking holidays or playing golf, and this is acceptable absence, around which they plan their laboratory research. However, the "culture" is suspicious of women who wish to plan their research to fit with family commitments.

Example: A young male scientist told me that this was a big problem for women; that they could not be in the lab for long enough if they wanted children, and that it was a source of difficulty for his wife (no need to affect him, it seems!) in trying to plan a family. He implied that she would probably have to leave science.

Qualifications

These attitudes and assumptions often mean that women feel they must be more highly qualified than a man doing a similar job, to be taken seriously.

Examples: One scientist recently told me that two years ago she had completed a part-time MSc, although comparable co-workers had only got first degrees. She had come to feel that she would stand no chance of promotion without it, despite regular commendations for her work. Her absences due to the day-release were a source of friction, and in the meantime, some of her male colleagues had been promoted. However, about a year after obtaining this qualification, she had been promoted, and now feels vindicated in her belief. At a different level, several very experienced women scientists have expressed to me similar reasons for obtaining a DSc.

3.2 *Practical problems*

Childcare

Children are the future of, and a resource for, the whole community; their care and wellbeing should therefore be the responsibility of the whole of society, rather than exclusively of the mother. In the long-term, a radical change in the way society view this responsibility is essential, if women (that is, over half of society) are not to be undervalued and frustrated in their attempts to fully utilise their talents. In the short term, however, improvement in the quantity of affordable accessible childcare facilities is essential.

I have been involved in investigations into the feasibility and costing of various workplace childcare facilities. Factors for consideration at any workplace are broadly similar; cost-effectiveness is generally the stated criterion. Nevertheless, my experience strongly suggests that the attitude of "top" management to such an enterprise is the crucial and deciding factor, since certain costs (eg, low staff morale) and some benefits (eg, less absenteeism for child-associated reasons) are difficult to quantify in advance, and rely on subjective assessments. Thus, it often comes down to "the bosses view" of a woman's role.

Care of the elderly or ill.

As with childcare, this is still generally seen as a woman's responsibility. I have been told by more than one woman that they have been given the impression by social and hospital workers, that they should give up their work, however important and skilled it may be, to look after relatives, simply because they are women.

Example: One hospital staff member involved with "aftercare" told me that they would look for alternative care more diligently if only male relatives exist, since males would not be expected to automatically give up work.

Effect of career breaks on CV and number of papers published.

Time off for caring and/or geographical relocation because of a partner's work means that women often have more varied experiences than men, reflected in a "mixed" CV with skills developed in a variety of in-work and out-of-work situations. Breaks often also mean a reduction in numbers of published papers. Since this "mixed" CV does not fit the typical (male) ideal, it is often seen as indicating less dedication (or even less ability) rather than more breadth of experience, flexibility and imagination. Hence less chance of the post—or particularly the promotion.

Examples: My own CV and that of Joan Mason probably typify this "mixed" CV and some of its consequences.

3.3 *Fixed-term contracts.*

Generally there is probably a place for such contracts, to provide early (eg immediate post-qualifying experience, provided there are sufficient more secure posts to follow. However, continually being on short fixed-term contracts, typically of three years, means that often the first year is spent setting up the work, and the final year is spent looking for the next post—which may also involve moving house each time. This means, with luck, one year of productive work in three. The proliferation of such contracts is counterproductive to good research.

Statistics suggest that an inordinately large proportion of women remain on these contracts, whilst the "permanent posts" go to men. I have heard men say that women like the flexibility to have a break and a baby every so often, I have never heard a woman put it like that. Those to whom I have spoken would prefer proper terms, conditions, and when appropriate, maternity leave.

3.4 *The promotion race – Women's "invisibility".*

Clubs and pubs.

Not all posts are openly advertised, even when they are, having friends on the inside helps. Your name is known, you know the ropes, and your face seems to fit. So you get the job. So how do you get known—easy, you join the right club; go for a drink with the boys after work; play golf with the lads. So why can't women do this? Culture again, seems to hold the answers, even when the practicalities allow it.

Example: Last week I was to attend the first meeting of a new research project; one woman with three men. I received a message that the meeting would start at two o'clock, but heard "on the grapevine" that two of the men had arranged to go for a drink in the pub before the meeting and had invited the third, it had not occurred to them to mention it to a woman—so I invited myself (assertive? or aggressive?). Had I been "late to the party", I may well have got the project "dregs".

The "short woman" problem.

This is NOT a frivolous point. I have asked many women about it, and I am surprised at how common the following perception is. On average women are shorter than men, some are very short. Many women feel that conversations among men where they are the only woman involved, are carried on "above their heads" and that they have to make a particular effort to be included, sometimes to the point of rudeness. Unless they can do this (not always easy), they are unable to contribute.

Example: Generally this may be unconscious behaviour, but one eminent woman scientist has a "colleague" who, when wishing to ignore her opinion deliberately looks over her head to address others.

3.5 *Suitability for the post.*

Women generally have to rely on the hard data on their CV, men often have the "network" advantages. But whatever the system at present for high-level scientific posts, the assessors are generally men, if women on average have different CVs, or different ways of approaching scientific questions (ie they are not enough like men) they are less likely to succeed. Conversely, if they do not dress or behave in an acceptably female way (ie they are too much like men), again they are less likely to succeed. And nifty power dressing in a laboratory setting is not very practical.

Examples: One woman scientist told me she definitely felt at a disadvantage in getting "noticed" because of the practical type of clothes her research necessitated; she has since left science to become an administrator, which she felt was necessary to get on. Another very well-qualified woman scientist was told she would "help her case" if she wore more "feminine" clothes at work.

3.6 *The "glass ceiling/elastic ceiling".*

The culmination of these various effects (and probably others) is the phenomenon of the glass—or worse, the elastic—ceiling. Woman are less likely to "rise to the top", but no single factor is identifiable.

Example: An exceptionally well-qualified woman scientist discovered she could apply to become a reader of her university. She did and the three international referees who assessed her application recommended that she should be considered for a chair rather than a readership (she was shown the letter that recommended this). Nevertheless, she was awarded only the readership and was heavily discouraged by the dean from subsequently applying for a personal chair (which she could do), despite such hostility she is considering this option.

3.7 *"Time will cure all."*

This is the platitude used when women challenge the status quo. However, without commitment from "the top" and a culture change, time will not cure all, and those changes will only happen if women continue to press their case.

Example: A study in a research organisation showed that although the same proportion of women as men had been promoted in the past three years, none of the women at the higher levels had been promoted, whereas males at all levels had been promoted. The effect over time therefore was to widen the seniority gap. In a discussion of the inequity of these findings, one woman was told, with a grin and a dismissive wave of the hand, that "perhaps no women were good enough". I would ask—according to whose assessment?

Conclusion.

There is still a long way to go before the loss to research of so much potential talent is halted. Time alone is not enough, anyone who cares about the future of good research in this country and a fair deal for women must continue to fight for change.

Evidence from Professor K R A Ziebeck, Department of Physics, Loughborough University of Technology

1. *Problems and advantages of current career structure*

Career structure for academic scientists inevitably starts with obtaining a PhD followed by a short-term postdoctoral position. Even after this period of about seven years after graduation, there is no guarantee of long-term academic employment since staff numbers in university departments are, at best, static despite the recent rapid increase in student numbers.

The requirement for outstanding academic qualifications and an extensive record of quality publications, coupled with low pay and rapidly-worsening conditions, make it more and more difficult for suitable experienced people in related professions in business and industry to transfer into academia. This situation, which is not of the universities' making or choosing, leaves them open to criticisms (usually made by the decision-makers who did create the conditions) of isolationism and lack of contact with the real world (Ivory Tower Syndrome).

One advantage of the postdoctoral system is that it gives the researcher insight into the university system before a final career decision is made. The probationary structure for the new academic has some merit in that it requires the probationer and the department to formulate an effective work plan which should aid further development. However, expectations for the probationer can be too high.

To progress through the lecturer scale competence in research, teaching and administration must be demonstrated. However, appointment to a Readership or Chair results from outstanding ability in research only. Over the last five to 10 years administrative duties have soared, leaving a diminishing amount of time for research.

The problems arise from:

- formula funding based primarily on student numbers which are falling for physics—10 per cent in the last five years;
- the decision by the HEFC(E) to fund physics with a unit of resource for physics of £4,641. This has plunged most physics departments into financial deficit. The consequences of this are that vacancies are frozen or lost and money for improving research and teaching, eg, laboratories, IT, is non-existent. Therefore quality in both areas declines, and with it, staff morale. The unit of research funding (£4,641) for physics, which is a laboratory-based subject, may be compared with the equivalent sum for chemistry (£7,690) and mathematics (£7,774). Mathematics is not a laboratory-based subject;
- expansion in undergraduate numbers has meant a general lowering of standards. Departments have been obliged to provide support for weaker students, thus increasing teaching loads;

— the incorporation of the polytechnics into the university system has lowered standards and further stretched resources.

If the unit of funding for physics is moved in line with similar subjects, then the career prospects for young staff will improve.

Except at Chair level, there is very little opportunity for staff to obtain promotion at other universities. Senior Lecturer or Reader posts are rarely advertised. This not only reduces individual opportunity; it also makes it very difficult to revitalise departments.

2. *Advantages and disadvantages of growth in short-term contracts*

Short-term Research Fellow or Assistant contracts have some merit in that experience of the university system is obtained, and so can act as a stepping stone to an academic career. However, permanent university jobs are very difficult to obtain, and the researcher has to spend a significant proportion of time applying for jobs outside the university system. The uncertainty of further employment after the end of a contract will be a constant worry to the researcher—especially if a family has to be supported—and could adversely affect the work.

In a period of increasing unemployment for research workers, encouraging the growth of short-term research posts will have a destabilising effect. University researchers should not be pressurised into short-term problem-solving for industry at the expense of long-term frontier research. The concept of "Wealth Creation" needs to be structured from a new base and not introduced on the back of existing systems, which have already allowed other countries to leap ahead of Britain. A major problem is that the Government White Paper is saying one thing whilst those expected to achieve it have little experience, either coming from the "pure research" sector of having given up research for administration. A fresh start is required with a new body, new people and finance coming from Government and industry. To date industry has not made any significant contribution to university research.

3. *How may the situation change in the next decade?*

No improvement in the situation can be envisaged in the next decade. Despite the large increase in the student/staff ratio in the last few years, the universities are still expected to achieve further efficiency savings, about 10 per cent over the next three years, which essentially means more students but the same number, or even fewer, academic staff.

4. *Information about destination of scientists leaving contract research sector*

University and Departmental records are kept. Since most physics departments are in deficit, vacancies are frozen or lost and therefore there is very little opportunity for contract researchers to obtain permanent posts in universities. Eroding academic freedom, diminishing time for research and poor salaries compared with other, less-demanding, professions combine to make a university career unattractive. Furthermore, the poor salaries and career structure in British industry often mean that research workers seek employment in the City or overseas. Over the last 15 years the Government has generated an image of success as being based entirely upon finance and wealth. For dedicated research workers, this usually means moving from short-term contract to short-term contract either until a permanent post is found or other pressures remove them from the system.

5. *Improvement of mobility of scientists between academia and industry*

The lack of interaction between British universities and industry compared with other countries, eg, Japan, Germany etc is mainly the fault of industrialists. Short-term monetarist attitudes have failed to capitalise on research carried out in British universities. Investment in university research by industry is negligible compared to Government investment. Any move to encourage interchange of staff between industry and universities must be structured so that neither career prospects nor home laboratories are damaged. The project must be correctly financed, ie, university staff should not subsidise industrial labs. Possible tax concessions for such exchanges may attract industrial participation. The present situation is one of entrepreneurial activity in high-level technology emerging from the universities rather than from industry, which results in technical advancement occuring in this country through the part-time activities of academics in universities, who are being harried by Government to spend even less time doing it.

6. *Situation concerning women*

Making careers in science more attractive to women must start at school level. By A level, twice as many boys as girls take science; but the success rate of the girls is actually better than that of the boys, which indicates no shortage of ability (Physics World, December 1994). The percentage of girls entering university science courses is also about the same as that taking A level. The main problem for women graduates' careers is that of having a family, since having time away from work, especially for an extended period, will clearly be disadvantageous to career prospects. The biological differences are difficult to surmount. Positive discrimination in favour of women would serve merely to generate resentment among male colleagues: female graduates do not appear to suffer any additional difficulties in finding employment compared with their male counterparts. There are just too few women in the system. In schools science is perceived as hard and a predominantly male domain. Furthermore, salaries are low compared to City-based jobs which can be obtained by studying less demanding subjects. Improved publicity could stress the importance of science to the community, eg, environmental issues and the significant role played by women. In the 60's Tomorrow's World did much to expand popular interest in science, and regular TV programmes aimed at primary and secondary school children are essential. The provision of more flexible permanent posts which allow for part-time employment should be attractive for women.

7. *MRes*

The MRes as a compulsory first stage towards a PhD has rightly been condemned by the academic community and by industry. With no overall increase in funding for postgraduate training, the introduction of such a compulsory course would see a decrease in the number of PhD students and a concentration of these in fewer universities.

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